L.I.F.E. Report

ENVIRONMENTAL AND HEALTH IMPACTS OF MIDWAY LANDFILL

An Assessment of Available Information and Procedures of the Closure Plan and Remedial Investigation Plan

DRAFT

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1.0 EXECUTIVE SUMMARY

This report was prepared by a team of independent scientific experts retained by L.I.F.E. to evaluate the adequacy of prior studies and proposed plans for the Midway Landfill. A performance matrix summarizing the team's evaluation is given as Table 1-1.

Existing data, prior studies, the Closure Plan and the Remedial Investigation Work Plan were reviewed from the viewpoint of air and water quality issues and public health concerns expressed by the community. In all three areas, existing data are generally inadequate as a basis for making conclusive judgements. Nevertheless, the L.I.F.E. team has been able to reach some conclusions:

* Concentrations of toxic landfill gas which were seeping into nearby basements before installation of the extraction wells were probably sufficient to have caused or exacerbated residents' symptoms of ill-health.

* Extraction wells and perimeter migration control systems installed in late 1985 have intercepted the underground gas reservoir, reduced migration of methane off-site to the east and greatly reduced residents' exposure to toxic gases.

* Surface and ground water in the landfill vicinity have been impacted by landfill leachate. Leachate is apparently moving away from the site in all directions.

The activities planned for the Remedial Investigation will provide valuable additional data. The L.I.F.E. team has made a number of detailed recommendations for improving the methodology and content of the RI. Important recommendations include:

* Creating a comprehensive data base for all samples and analyses related to the Midway Landfill. in RI

* Expanding the planned sampling program to include correlation with barometric pressure, additional off-site monitoring wells, ambient air sampling and systematic water level and water quality monitoring both on and off site.

* Planning a more realistic time frame for the Remedial Investigation, allowing 18 - 24 months, to ensure that all planned activities can be completed. scheduled for 12 mo.

* Considering additive and synergistic health impacts resulting from exposure to multiple toxic substances as part of the endangerment assessment.

* The most important recommendation is that the City should not wait for completion of the RI/FS to begin implementing interim ~~remedial~~ actions. what actions?

The Draft Closure Plan is generally consistent with good landfill practice. With improvements recommended by the L.I.F.E. team, the proposed actions should eliminate potential air pollution and methane hazards and reduce impacts on local surface and ground water. Actions that should be undertaken as soon as possible include:

* Constructing a security fence around the landfill perimeter

* Installing a leachate collection/treatment/disposal system

* Permanently diverting all surface water runon away from the site

all a part of Closure Plan

Table 1-1
Performance Matrix

	Adequate	Inadequate	Unknown	Comments
Prior Studies				
Air	x			Early sampling used as a basis for the DEIS was inadequate. Recent sampling generally has been adequate with 3 exceptions: - Sampling does not account for fluctuations in barometric pressure - Insufficient number of deep wells - Minimal ambient air sampling
Water		x		- Minimal sampling - No comprehensive data base - No ground water sampling after 1985
Health		x		Too few chemicals were considered and interactions were ignored. Because of the inadequacy of the toxicology data base, no safe exposure levels can be determined.
Planned Studies (RI)				
Air	x			Assuming improvements suggested by L.I.F.E. team are implemented
Water			x	Cannot be determined because detailed methods not given RI - sampling Plan
Health	x	how?		Generally adequate except for the failure to include consideration of interacting or additive effects of many toxic substances to which people are exposed
Improvements to Date				
Air	x			Extraction wells and perimeter migration control systems installed in late 1985 apparently have reduced concentrations of methane and volatile organic gases.
Water Water		x		Other than partial filling of South Pond, L.I.F.E. team is unaware of any improvements to date.
Health	x			Improvements have greatly reduced residents' exposure to toxic gases.

Table 1-1 Continued

	Adequate	Inadequate	Unknown	Comments
Improvements Proposed (Closure Plan)				
Air	X			With improvements recommended by the L.I.F.E. team, the plan will have high probability of eliminating potential air pollution and methane hazard.
Water	X			Plan is generally adequate but lacks detail. Proposed improvements will not be effective unless inflow of water to the landfill is permanently stopped.
Health			X	Draft Closure Plan does not consider public health issues.
Timing & Scheduling				
Air	X			Preliminary design and engineering feasibility studies on more advanced combustion and energy recovery systems should be done now, not after the final odor control system is installed.
Water		X		Implementation of Closure Plan and other reasonable actions should begin now. RI could require 18-21 months to complete.
Health		X		Ambient air sampling off site should not be postponed any longer.

2.0 INTRODUCTION

2.1 PROBLEM

In recent years, residents of the community surrounding the City of Seattle's Midway Landfill have become increasingly concerned about the potential environmental and health effects of landfill gases and leachate discharging from the landfill.

During its operation from 1966-1983, over 3 million cubic yards of various wastes were disposed in the abandoned gravel pit at Midway. Even though the City declared that only nonputrescible wastes would be accepted, putrescible and hazardous wastes were accepted.

At the Midway site, water infiltrating through the refuse creates leachate and anerobic conditions necessary to generate methane and other landfill gases. Leachate migrates from the site and contaminates surface and ground water resources. Landfill gases have migrated from the site and invaded private properties.

Some of the City's remedial efforts appear to have reduced the off-site migration of landfill gas. However, controlling the impacts of the landfill on air and water has been and will be difficult because of poor management decisions in the past including:

* Improper siting in permeable sand and gravel
* Acceptance of putrescible wastes for disposal
* Acceptance of potentially hazardous wastes
* Improper handling of wastes and facility (e.g. lack of daily cover, inadequate compaction, excess surface water runon)
* Slow moving and inadequate efforts to define the character and extent of the environmental problem

2.2 ACTION TO DATE

Since its closure in 1983, the City and regulatory agencies have taken a number of technical and remedial steps to mitigate the landfill impacts. These actions included:

* Addition of fill material to topographically low areas
* Installation of on and off-site landfill gas (LFG) probes
* Monitoring of LFG
* Installation of on and off-site LFG extraction wells
* Operation of LFG extraction wells

* Installation of on and off-site ground water monitoring wells

* Monitoring of ground water levels and water quality

* Monitoring of surface water quality

* Preparation of a receptor study

* Support of the L.I.F.E. Technical Advisory Team (TAT)

* Preparation of many reports of findings and recommendations

Initial investigative efforts focused on preparation of a site Closure Plan, which was released in draft form on September 15, 1986. Seattle's City Council is scheduled to act on this plan in December, 1986. The Draft proposed the following plans:

* Final Grading/Site Development Plan

* Leachate Management Plan

* Final Cover System

* Surface Water Management Plan

* Landfill Gas Management Plan

* Post-Closure Plan

* Implementation Plan

In 1986, as a result of the initial findings regarding LFG and water quality, the U.S. Environmental Protection Agency (EPA) added Midway to the "Superfund List." This designation initiated a planning process for a Remedial Investigation and Feasibility Study (RI/FS) to be managed by the Washington State Department of Ecology (DOE). Federal and State regulations require that all RI/FS work be performed to demanding technical specifications. On October 3, 1986 the City of Seattle agreed by consent order to fund the proposed RI/FS.

2.3 L.I.F.E. STUDY

L.I.F.E., a non-profit corporation representing over 180 families in the Midway area, was organized to educate and inform Midway citizens about the Midway Landfill problem. Members of L.I.F.E. expressed concern about the possible bias of information made available to them from the City, County and State. In May 1986, the City of Seattle agreed to reimburse L.I.F.E. for the costs of retaining independent scientific experts to evaluate existing conditions and proposed plans with regard to environmental degradation and health problems. In May, L.I.F.E. retained the technical advisory team (TAT) of Carr/Associates, Seton, Johnson and Odell and Ruth Shearer to provide them with this independent expertise.

2.4 OBJECTIVES

The original objectives of the TAT were to:

* Evaluate the adequacy and accuracy of prior testing
* Insure that all existing data is made available
* Determine additional data requirements, if any
* Establish technical dialogue with the City
* Encourage the City to fill data gaps and correct any oversights

Additional objectives have been to:

* Evaluate the adequacy, effectiveness and appropriateness of actions proposed in the City's Draft Closure Plan
* Evaluate the adequacy, effectiveness and appropriateness of methods and procedures being used in the Remedial Investigation/Feasibility Study RI/FS

Specifically, the consultant team was asked to answer questions such as the following:

* Are all reasonable measures being taken to contain the methane?
* What other measures could or should be taken?
* Are adequate safeguards built into the existing methane containment measures to assure that they will continue to function?
* What is the best projection of what will happen in the future with regard to the methane?
* Are there any other problems which should be anticipated and studied, such as water quality?
* Should studies of health effects be conducted? If so, what type of studies should be done?

2.5 GENERAL APPROACH

Because of the limited initial funds available to the TAT, no independent sampling has been performed. The evaluations provided in this report are based on existing data provided by the City and regulatory agencies, and on direct observations of various features of the landfill and surrounding area.

Working in their individual areas of expertise, team members have approached this study as follows:

* Interviewing City and regulatory officials

* Discussing issues with L.I.F.E. members and other members of the community

* Collecting and reviewing existing data and reports pertaining to the Midway Landfill

* Reviewing documents from landfill data base searches collected by others

* Attending public meetings presented by Seattle and regulatory agencies

Seattle's funding of the L.I.F.E. team's review demonstrates the City's real interest in understanding and resolving the Midway Landfill problem. Unfortunately, the inadequacies of the early data collection programs have prevented the TAT from presenting conclusive answers to many of the community's concerns in this report.

2.6 PURPOSE AND DESCRIPTION OF REPORT

This report has two purposes:

1. To inform the local community of technical adequacies of work done

2. To encourage the City's timely implementation of technically sound remedial actions

The TAT has attempted to present clear and concise discussions of the technical information. This report has three technical sections which present the findings for air, water and health considerations. Figures, tables and background information follow the text of each section. Documents reviewed by the TAT and referenced in the text are listed at the end of the report.

3.0 FINDINGS: AIR

3.1 ISSUES AND CONCERNS

Gaseous emissions from the Midway Landfill pose two distinct concerns for residents of the adjacent community: methane hazard and air pollution by toxic gases. Both have been studied and, to an extent, dealt with by Seattle and D.O.E., and have been evaluated by the L.I.F.E. team.

3.1.1 Methane

The methane hazard is well known. A continuing series of revelations disclosed the existence of potentially explosive concentrations of methane in several homes, then a substantial "pocket" of gas underlying the Linda Heights neighborhood, which subsequently became a "reservoir" that has grown in size as additional gas wells were drilled by DOE and Seattle. Extraction wells, totalling 17 to date, have been put into operation to withdraw gas from the reservoir and appear to be effective in accomplishing that task.

The community's concerns with respect to methane are three: (1) has the full extent of methane migration been identified; (2) will the closure plan effectively eliminate the migration of methane and the need for extraction wells; and (3) are there presently, or have there been, in the recent past, health hazards associated with the extraction wells.

3.1.2 Air Pollution

Air pollution from Midway Landfill comes from three potential sources: leaks of gas from cracks in the cover or other means of natural venting from underground; from the odor and gas control flares on the site; and from the extraction wells east of the site. The pollutants of concern include hydrogen sulfide and a great number of volatile organic gases that have been identified as hazardous pollutants.

That hazardous pollutants have been identified in emissions from the landfill, from flares and from extraction wells is an important fact. The critical question, however, is whether the quantity of emissions, and the resulting concentrations of them in the ambient air (the air that people breathe) is high enough to affect the community's health or welfare.

The focus of the L.I.F.E. team's air quality study has been to evaluate the data collected by DOE and Seattle for accuracy and adequacy, and then make an independent interpretation of what it tells us about air pollution in the community. This section

of the report deals with the question of amounts--how much of what kind of pollutants are emitted from what sources, and how much is in the air that people breathe. Section 5 relates these findings to potential effects on people's health.

A few definitions will help clarify the somewhat technical discussion that follows.

Emissions - pollutants at their point of origin.

Ambient Air - the outdoor air, as differentiated from air in a smoke stack or inside a building.

Dispersion - the process by which pollutants are carried from the point in the ambient air at which they are measured, breathed or otherwise experienced by people. Dispersion is governed primarily by wind speed, wind direction, atmospheric mixing, and topography.

Concentration - the measure of how much pollution is in air. It is measured in terms of weight per volume (usually micrograms of pollutant per cubic meter of air) or volume per volume, as in parts per million (ppm) which is cubic meters of gaseous pollutant per million cubic meters of air. Concentrations may apply either to emissions or to pollutants in the ambient air.

3.2 EVALUATION OF DATA

This section describes and assesses the adequacy of air quality data collected to date, and interprets its meaning for the residents of the community.

3.2.1 Sampling Activities to Date

Table 3-1 lists nine air sampling data sets that have been reported in the environmental impact documents for Midway, or otherwise have been provided by the Department of Ecology to the L.I.F.E. consultants. We believe this summary includes all the significant air quality and methane data that has been generated to date. It does not include planned future work to be done under the Remedial Investigation sampling program.

Data sets 1, 2 and 3 represent the air quality data on which the Draft Environmental Statement (DEIS) was based. By inspection, the volume of data is small compared with activity to date in 1986. The data was an inadequate basis for evaluating the air quality impacts of the landfill or for determining the requirements for mitigation under the closure plan.

Early results from data sets 4 through 9 were used in the Final E.I.S., including the health effects evaluation by the University of Washington Department of Environmental Health. Data sets 4-7 are the results of ongoing sampling programs being carried on at the present time.

3.2.2 Adequacy and Accuracy

The analytical methods used in the more recent and extensive activities, including data sets 4-8 are, in our opinion, consistent with good scientific practice and produce good results for the samples taken. We have one general criticism, however, of the sampling program: that it is not designed to account for the way landfill gas emissions are known to fluctuate as barometric pressure changes.

Studies elsewhere have shown that methane migration increases rapidly when atmospheric pressure drops. Gas concentrations thus can vary drastically not only from day to day, but from hour to hour. For example, methane concentrations at one site reported in the literature (Ref. 3-1) went from 0 to 26% and back to 0 again in a 22 hour period, while the barometer dropped from 30.32 inches to 29.73 inches. Most of the DOE and Seattle data is taken as a single sample from a given probe on any day, and is not correlated with barometric pressure. Only by observing the trend of a large number of samples can we be confident that the results are meaningful. Data from any site that has not been repetitively sampled should be treated skeptically. Fortunately, however, most sites have been sampled often enough that the results can be trusted for interpretation.

Another potential problem with the methane data is in the depth of the probes and wells. Of the approximately 112 probes and wells drilled around the site, 68 are classified as "shallow" wells, extending only about 10 feet below the surface. Twenty-seven are drilled deep and have sampling lines to 3 different levels: shallow (10 ft.), medium (40-50 ft.) and deep (70-100 ft.). Four probes have shallow and medium ports, or medium and deep sampling capability. The remaining 15 wells are deep extraction wells that apparently extract gas from all levels of a deep hole, resulting in a depth-averaged sample.

The problem that this diversity of well depths introduces to the task of interpreting the data is that the distribution of 3-level wells leaves some areas in the surrounding neighborhood untested or only partially tested for deep-lying pockets of methane. This will be discussed under Section 3.2.3 below.

Data set 9 is important in that it represents the only effort to date to sample ambient air in the community for volatile organics. Unfortunately, it is limited not only in the number of samples (2 at one location, 1 at another), but also in the sample method. The samples were collected in a Tedlar (plastic) bag over a few minutes time, and thus represent no more than an instantaneous snapshot of what was going on in the particular spot at the time. They are subject to local interferences, and conclusions drawn from them must be carefully conditioned. It would be much preferable to have ambient samples collected over an 8 to 24 hour period, as they will be in the Remedial Investigation/Feasibility Study program.

Another important aspect of data set 9 is that it provides a comparison of ambient levels of organic gses in the Linda Heights area with those in an area not affected by Midway. Of the three samples, two are from 222 Elaine Court, 2 1/2 miles south of Midway near the west side of the I-5 freeway. The other sample is from the playground at the Community Baptist Church at 250th and Military Road.

Table 3-2 is a summary of data showing the measured or estimated concentration of organic gases in on-site landfill gas, extraction wells, and ambient air. Figure 3-1 shows the location of most of the gas probes and extraction wells in the area. Figure 3-2 shows a typical trend of organic gases and methane concentrations in an extraction well for the first 8 months of 1986.

The L.I.F.E. team examined the results of sampling events in which concentrations of volatile organic gases were measured at the same time in the inlet and outlet to the carbon filters installed on extraction wells. The 12 events results in a total of 88 individual pairs of data for individual organic compounds that were detected at measurable concentrations in either the inlet or outlet. In 45 of these pairs (51%), the outlet concentration was lower than the inlet, 46% of the cases the outlet was higher, and there was no difference between inlet and outlet in 3% of the sample pairs.

3.2.3 Interpretation of Data

Our evaluation of the Midway air quality data leads the L.I.F.E. team to the following conclusions:

Methane

1. The extent of methane migration has been well identified to the east of the site, but less so elsewhere. The existence of deep lying gas is basically undefined to the north,

northwest and southwest because of the absence or scarcity of deep probes. Recent sampling in the south and southeast have established the existence of gas as far south as Reith Road; resulting in a new extraction well being established at the corner of Reith Rd. and Military Rd. Figure 3-1 shows areas where deep-lying methane has been found in addition to the shallow reservoir identified in the FEIS.

2. Wherever extraction wells have been established, they have successfully reduced the measured concentrations of methane within a few months time to levels below, or near, the "safe" level of 5%. Figure 3-2 is a typical extraction well methane trend.

3. Based on the data from probes L, M, N, and O, the migration of gas from the landfill toward the east was greatly reduced between September 1985 and February 1986, apparently as a result of the new perimeter gas control wells installed on the landfill site in late 1985. Some uncertainty is introduced into this conclusion, however, by the concurrent startup in early 1986 of extraction wells near the three probes with the highest concentrations.

Volatile Organic Gases

1. Many of the same organic gases that have been identified in the gas being flared on the landfill site have also been measured in the gas being extracted from the underground reservoir east of the freeway. The concentrations of these compounds are much lower, however--from 90% to 99% less than the concentrations found in the on-site landfill gas. This fact supports the claim made in the EIS and elsewhere that the organic gases are absorbed by the soil as the landfill gas travels from the refuse site to the underground reservoir underlying the extraction wells.

2. The analysis of sampling data for the inlets and outlets of extraction wells carbon filters leads to the conclusion that filters on the DOE extraction wells prior to April 17, 1986 and the Seattle wells as late as 7/25/86 were for the most part ineffective in removing volatile organic gases. DOE and Seattle have recognized this problem and have replaced the original filters with larger units.

3. The extremely limited ambient air sampling done to date by DOE found measurable concentrations of several organic gases, at levels comparable to these found in the extraction wells. In general, however, higher concentrations were found just west of I-5 at a location 2 1/2 miles south of the landfill than were found at the

Community Baptist Church near DOE extraction well E-2. This suggests that the concentrations of organics in the extraction wells are comparable to the background levels found in urban air due to motor vehicles and other sources of hydrocarbon gases.

4. If one considers the extraction wells as point sources of pollution, their maximum contribution to ambient concentrations of organic gases can be estimated to be less than 0.5 microgram per cubic meter, or less than .001 ppm of total non-methane hydrocarbons. For any specific chemical, extraction wells would be expected to contribute less than 0.2 micrograms per cubic meter or 0.0001 ppm to the ambient concentration. This estimate supports the finding in (2) above that concentrations of organic gases in the area east of the freeway have not been appreciably increased above background levels by the operation of extraction wells.

5. Whatever increase of organic gases may have resulted from early operation of the extraction wells, concentrations have declined and improved the situation as the reservoir of gas has been reduced. The reduction of organic concentrations in extraction well gas has been clearly shown in the data.

3.2.4 Additional Data Required

Although the foregoing interpretations of data suggest a favorable trend in emissions of methane and organic gases, and suggest that air quality impacts of the landfill may be small, it must be emphasized that the analysis is based primarily on measured source concentrations in extraction wells and probes, with some theoretical extrapolation to estimate ambient air impacts. Actual ambient air sampling is minimal.

In order to determine conclusively what impact, if any, the operation of the Midway site and the off-site extraction wells may have on air quality in the community, additional ambient air sampling is needed. This is discussed in Section 3.3 below in relation to the RI/FS.

As the underground gas reservoir is pumped out by extraction wells and the rate of gas migration is reduced by the on-site gas collection system, existing monitoring wells east of the freeway become less useful for determining whether migration is occurring. New off-site probes closer to the site are needed to detect any additional migration. This need is discussed below in relation to the Closure Plan. The ongoing sampling program should include continuous monitoring, recording and

reporting of barometric pressure so it can be correlated with gas sampling data.

3.3 ADEQUACY OF PLANNED ACTIONS

3.3.1 Closure Plan

The L.I.F.E. team examined the Closure Plan document dated September 1986 and submitted comments to the Seattle City Council (Appendix 3B). The following points summarize our conclusions:

1. The proposed gas migration control system is a conventional one and will probably work. However, Seattle should investigate an alternative system based on perimeter air injection wells rather than perimeter extraction wells as planned. This alternative approach has been successfully applied in a number of landfills elsewhere, and where feasible, provides a more positive measure of control that is not affected by changes in barometric pressure as is the conventional system of perimeter extraction wells. (Refs. 3-2, 3-3, 3-4)

2. If air injection is not feasible at Midway due to geologic or other site-related restrictions, new perimeter probes should be established and monitored continuously for methane, to verify effective elimination of migration.

3. The proposed on-site odor control system should be upgraded to include continuous monitoring and control of extraction volumes and combustion air in order to minimize oxygen infiltration into the refuse (to prevent a fire hazard) while maximizing methane recovery and combustion efficiency.

4. The proposed combustion flare system, while commonly accepted as Best Available Control Technology in Southern California and elsewhere (Refs. 3-5), will not necessarily produce the greatest possible control of gaseous emissions and odor. Higher levels of control are possible, and could be easily integrated with an energy recovery system.

5. The Closure Plan fails to address the potential for energy recovery from the landfill gas; thereby failing to meet a committment made in the EIS. An evaluation of energy recovery potential should be made at this time.

6. The post-closure monitoring plan does not address the fact that methane migration from landfills fluctuates widely in response to changes in barometric pressure. A program of continuous monitoring or repetitive sampling should be

incorporated into the plan. We understand that DOE has recently recognized this need and established a recording barometer at the site.

3.3.2 Remedial Investigation/Feasibility Study

The L.I.F.E. team evaluated the RI/FS documents presented by DOE and Seattle, wrote a letter of comment regarding air quality, and obtained committments from DOE for several important changes to the sampling program and analytical methods (Appendix 3C and 3D). These improvements are summarized as follows:

1. The ambient air sampling program will include sampling during period of low wind speeds and calms, the times when maximum concentrations of pollutants are to be expected. The original RI proposal was to sample only when wind speeds were above the 2 to 3 mph under which dispersion modeling analysis can be done.

2. Additional sampling for organic gases will be done in the neighborhoods near the extraction wells, collecting 8 to 24 hour integrated samples. This data will determine conclusively whether extraction wells pose any hazard for the community.

3. The air quality modeling work, by which limited sampling data is mathematically extrapolated to cover a broader area and time period, will be based on an acceptable computer simulation model far superior to that used by the University of Washington in the DEIS and FEIS work.

4. The L.I.F.E. team consultant will be given an opportunity to participate in the design of the sampling program for the new combustion flares, which are a difficult source to test accurately.

3.4 CONCLUSIONS

The data examined in this study allows only a limited evaluation of what effect the Midway Landfill may have had on the surrounding community prior to 1986. Clearly, there was a methane migration problem that resulted in the need to evacuate people from their homes and establish off-site gas extraction wells. With respect to organic gases, it is reasonable to conclude that there was little impact from gas migrating off-site. The impact of organic emissions from the landfill site itself is a matter of speculation that can not be addressed without better data.

What is very clear, however, is that the air quality aspects of Midway have improved markedly during the last year. Specifically, the foregoing data and discussion support the following conclusions:

1. Migration of methane off-site toward the east appears to have been greatly reduced by the new series of perimeter extraction wells now being vented to the odor control system.

2. The underground gas reservoir, while still being defined, is being effectively drained by the extraction wells.

3. The impact of the extraction wells on local concentrations of organic gases appears to have been small, and will continue to decrease as the underground gas reservoir is depleted. This conclusion should and will be tested in the ambient air sampling program of the Remedial Investigation.

4. The Closure Plan as proposed by Seattle is not bad from an air quality standpoint. If improved as suggested by the L.I.F.E. team, it will have a high probability of eliminating any potential air pollution or methane hazard from the site.

5. The Remedial Investigation, as amended following our comments, will produce adequate data for a final evaluation of the Closure Plan and its air quality requirements.

3.5 RECOMMENDATIONS

The following list of recommendations summarizes the foregoing discussion:

<u>The City of Seattle should</u>:

1. Consider air injection as an alternative to perimeter extraction wells for gas migration control.

2. Establish new perimeter gas probes to monitor migration.

3. Improve monitoring and control of the odor control gas extraction and combustion system.

4. Conduct a preliminary engineering design evaluation of an improved landfill gas combustion system.

5. Carry out the study of energy recovery committed to in the DEIS.

6. Design a sampling and monitoring program that addresses the known fluctuation of gas migration with barometric pressure.

7. Conduct air sampling on-site and off-site during periods of low wind speed.

8. Emphasize ambient air sampling in the off-site community to determine conclusively whether on-site operations or extraction wells have an impact on concentrations of organic gases.

9. Use EPA's Industrial Source Complex computer model, or one of comparable sophistication, to relate source emissions data to ambient air concentrations.

In addition to these recommendations for the City, there are several additional areas of investigation that we believe it would be appropriate for the L.I.F.E. team to followup on. They are listed below for L.I.F.E. to consider and determine whether they wish to direct the consultants to undertake the appropriate activity:

1. Review proposed methodology and observe the emission testing of the combustion flares.

2. Carry out an independent review of the technical and economic feasibility of energy recovery, combined with improved emission control, from burning of landfill gas.

3. Work with DOE and Seattle to develop improved means of communicating air sampling results to the public. Specifically, a quarterly report with computer-generated graphics showing the trends of results in representative wells and probes would be of use to agency staff as well as the public in monitoring the results of Closure and the RI/FS plan.

TABLE 3-1
INVENTORY OF GAS AND AIR SAMPLING ACTIVITIES

DATA SET	CONTAMINANT	LOCATIONS	DATES	NO. SAMPLES	COMMENTS	ONGOING PROGRAM
1.	Ammonia, hydrogen chloride, sulfur dioxide, hydrogen sulfide	Ambient air on site and south of site	June '83	4	Amtest; by NIOSH methods (indicator tubes	NO
2.	Volatile organics, H_2S, CN	Unlit vent gas from flare system	April '84	6	Laucks Testing Labs; only one sample for organics	NO
3.	Volatile organics, H_2S, CN	Unlit vent gas from flare system	May '85	3	Univ. of Washington	NO
4.	Methane	Probes A-P (multi-level	4/85 - Present	Approx. 3400	Typically 2/week at each probe.	YES
5.	Methane	Probes 02-92	12/85 - Present	Approx. 3000	Amount of data varies at different probes.	YES
6.	Methane	Extraction Wells C1 - C12, E1, E2	1/86 - Present	800-900	Irregular sample intervals.	YES
7.	Volatile Organics	Gas extraction wells	2/86 - Present	60	By Analytical Technologies, Inc. for Black & Veatch for DOE; 1 to 16 samples per site; includes inlet and outlet of carbon filters.	YES
8.	Volatile Organics	9 selected probes	5/86 - 6/86	10	By Black & Veatch for DOE.	NO
9.	Volatile Organics	Ambient air - 2 locations	Feb. - March, 1986	3	Grab samples by ATI for Black & Veatch for DOE.	NO

TABLE 3-2 MIDWAY LANDFILL AREA - VOLATILE ORGANIC GASES - CONCENTRATIONS IN MILLIGRAMS/CUBIC METER

COMPOUND	SOURCE EMISSIONS UNLIT FLARES (1)		MEDIAN VALUES- DOE EXTRACTION WELL E-1 (4)		DEIS ESTIMATED MAXIMUM IMPACTS AT SITE (5)		AMBIENT AIR GRAB SAMPLES MARCH 1986 (6)		ORDER OF MAG. (7) AMBIENT FROM EXTRACTION WELL
	MAX.	AVG.	INLET	OUTLET	PRED. VALUE	OBSERVED MAXIMUM	BAPTIST CHURCH	ELAINE COURT	
ACETONE	2.2	1.3	0.19	0.08	2.80	ND	0.12	0.36	0.00001
BENZENE	321.0(2)	173.0(2)	0.12	0.12	418.00	29.00	ND	ND	0.00001
2-BUTANONE	TR	TR	0.15	0.14	0.60	ND	0.10	0.35	0.00001
CARBON DISULFIDE	NA	NA	0.29	0.07	NA	NA	0.12	0.34	0.00001
CHLOROBENZENE	TR	TR	0.30	ND	L/.06	ND	ND	ND	0.00001
CHLOROETHANE	ND	ND	0.27	0.29	0.30	ND	ND	ND	0.00003
CHLOROFORM	ND	ND	ND	ND	L/.06	ND	ND	ND	ND
CHLOROMETHANE	NA	NA	1.10	ND	NA	NA	ND	0.11	ND
1,1-DICHLOROETHYLENE	TR	TR	0.03	0.02	0.60	ND	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	0.02	0.03	0.60	ND	ND	ND	ND
1,2-DICHLOROETHANE	2.3	0.8	ND	ND	3.00	ND	ND	ND	ND
TRANS-1,2-DICHLOROETHYLENE	TR	TR	0.35	0.45	1.10	ND	ND	ND	0.00003
1,2-DICHLOROPROPANE	ND	ND	ND	ND	0.06	ND	NA	NA	ND
ETHYL BENZENE	NA	NA	0.35	0.27	NA	NA	ND	0.14	0.00003
HYDROGEN SULFIDE	24.0	13.0	NA	NA	70.00	ND	NA	NA	NA
ISOOCTANE	9.3	5.0	NA	NA	17.00	ND	NA	NA	NA
LIMONENE	43.0	31.0	NA	NA	55.00	ND	NA	NA	NA
METHYLENE CHLORIDE	10.7	5.0	0.82	0.27	14.00	ND	0.40	3.85	0.00003
4-METHYL-2-PENTANONE	TR	TR	ND	ND	4.20	ND	ND	ND	ND
NONANE	32.0	29.0	NA	NA	42.00	ND	NA	NA	NA
OCTANE	21.0	13.0	NA	NA	27.00	ND	NA	NA	NA
1,1,2,2-TETRACHLOROETHANE	ND	ND	0.09	ND	L/.2	ND	ND	ND	ND
TETRACHLOROETHYLENE	8.5	6.7	0.26	0.29	11.00	ND	ND	ND	0.00003
TOLUENE	139.0	51.0	0.28	ND	181.00	1.00	0.05	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	1.30	ND	ND	ND	ND
TRICHLOROETHYLENE	122.0	41.0	0.28	0.33	158.00	7.00	ND	ND	0.00003
VINYL CHLORIDE	NR	NR	1.95	1.70	0.17	ND	ND	ND	0.00020
XYLENE	190.0(3)	101.0	1.49	0.41	247.00	4.00	0.28	0.28	0.00004
TOTALS	1336.80	470.80	8.34	4.47	1255.05	41.00	1.07	5.43	0.00047

NOTES:
(1) ANALYSIS CONDUCTED BY UNIVERSITY OF WASHINGTON, 1985
AVG. = ARITHMETIC AVERAGE OF FLARES #5,13 25; DATA REPORTED IN DEIS.
(2) UW ANALYSIS DID NOT DISTINGUISH BENZENE FROM CARBON TETRACHLORIDE.
(3) UW ANALYSIS DID NOT DISTINGUISH XYLENE FROM ETHYLBENZENE.
(4) DATA EXTRACTED BY SETON, JOHNSON & ODELL FROM DOE DATA BY BLACK & VEATCH; DATA REPRESENTS OUTLET OF CARBON FILTER.
(5) DATA REPORTED IN FEIS, TABLES 5 AND 7.
(6) SAMPLES BY BLACK & VEATCH FOR DOE; BAPTIST CHURCH AT 250TH AND MILITARY ROAD; ELAINE COURT AT 290TH AND I-5, 2.5 MILES SOUTH OF LANDFILL.
(7) MEDIAN VALUES OF EXTRACTION GAS DIVIDED BY 10,000 AS AN ORDER OF MAGNITUDE APPROXIMATION OF 24 HOUR AVG. CONCENTRATIONS FROM EXTRACTION WELLS.

LEGEND:
'L/' = LESS THAN; ND = NOT DETECTED ABOVE DETECTION LIMIT OF .1 TO .2 MG/M3; TR = DETECTED AT TRACE LEVELS; NA = NOT ANALYZED FOR; NR = NOT REPORTED.

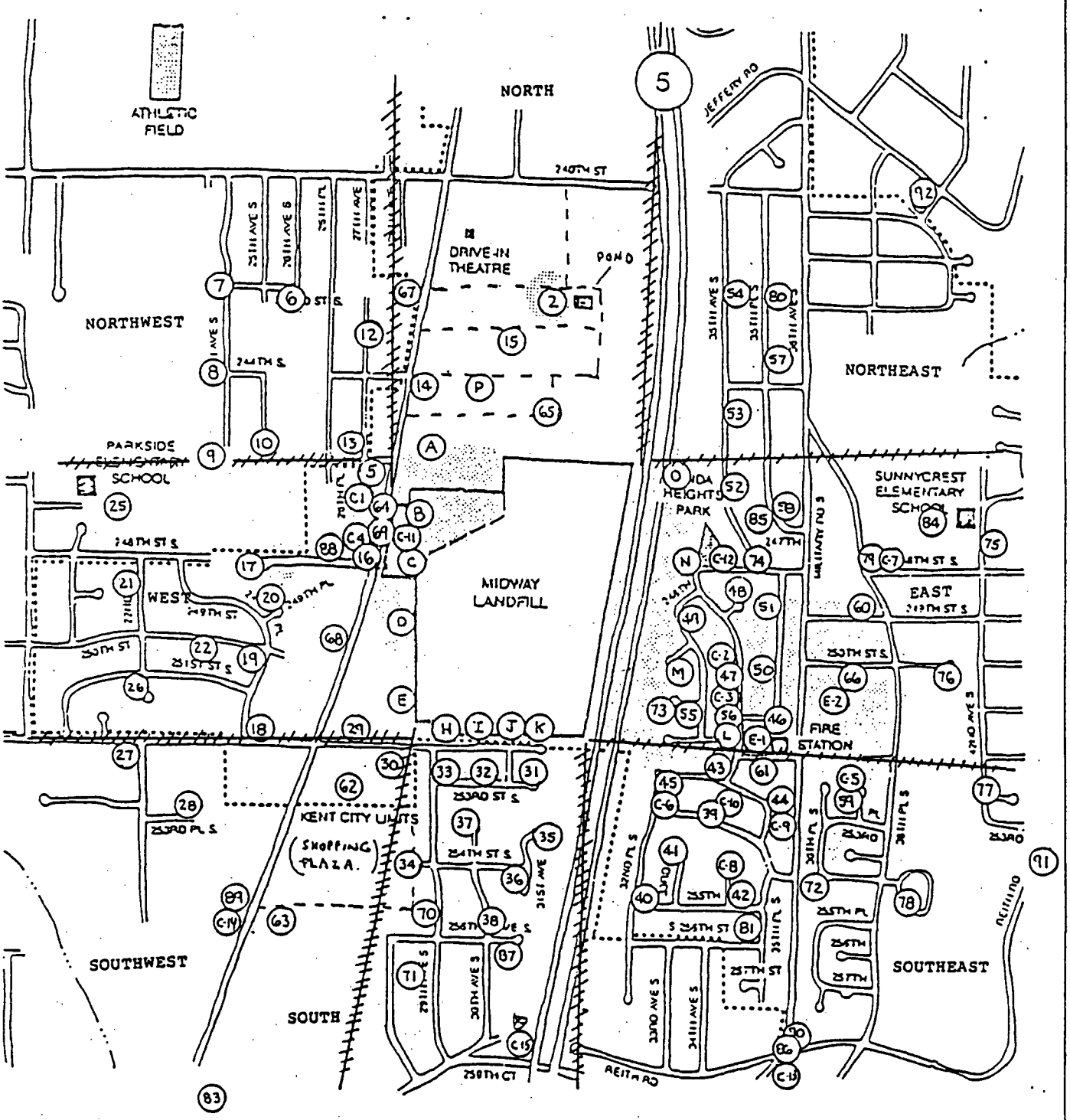

FIGURE 3-1 - GAS SAMPLING PROBES AND EXTRACTION WELLS

LEGEND:
- A - P : 3-level probes
- 2 -92 : single or multi-level probes
- C-1 - C-15 : City of Seattle gas extraction wells
- E-1, E-2 : Department of Ecology extraction wells

PREPARED BY: L.I.F.E./T.A.T. 10/86

FIGURE 3-2

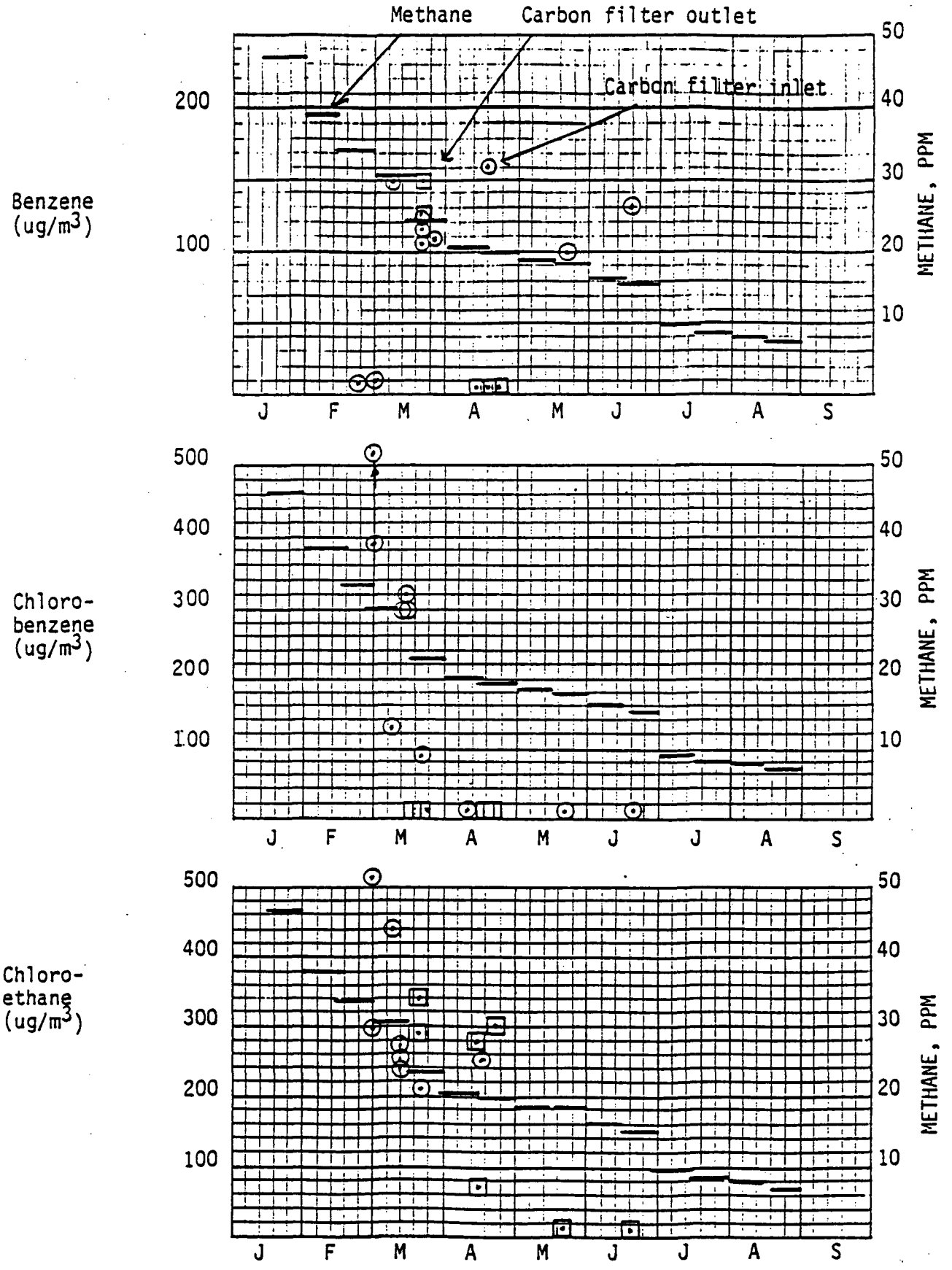

Figure 3-2 Ecology Well No. 1 - Volatile Organics and Methane

PREPARED BY: L.I.F.E./T.A.T. 10/86

APPENDIX 3A

SUMMARY OF OFF-SITE METHANE DATA

SECTION	PHASE/WELL	DEPTH	RANGE	TREND/COMMENT
North	A	S,M,D	86%-O	Initially high all 3 levels, S&M reduced to O, D to 30%
	P	S,M,D	------	Probe blocked, all 3 levels
	2	S,M,D	100%-0	No reduction in shallow probe (40%); deep probe 1-10%.
	14	S	<1%	Poor sample date
	15	S	<1%	Limited data
	65	S	<1%	---------
Northwest	6	S	<1%	---------
	7	S	<1%	Probe blocked with water
	8	S	0-16%	Probe blocked with water
	9	S	-----	Water in probe
	10	S	0-16%	Typically 2-6%, no decrease
	12	S	<1%	----------
	13	S	<1%	----------
	67	S	<1%	----------
West	B	S,M,D	66%-0	Reduced to <1%, all levels
	C	S,M,D	62%-0	Reduced to <1%, all levels
	D	S,M,D	70%-0	Reduced to <1%, all levels
	E	S,M,D	-----	No data - probe blocked
	C-1	D	0.1-0.6%	No change with time
	C-4	D	6%-.1%	Apparent decrease with time
	C-11	---	------	No data

SECTION	PHASE/WELL	DEPTH	RANGE	TREND/COMMENT
	5	S	<1%	----------
	16	S	<1%	----------
	17	S	34%-1%	Apparent increase with time
	18	S	------	Poor data
	19	S	<1%	----------
	20	S	<1%	----------
	21	S	<1%	----------
	22	S	<1%	----------
	25	S	------	No data - water in probe
	26	S	<1%	----------
	29	S	<1%	----------
	64	S	53%-1%	All <1% since May '86
	69	S	<1%	----------
	88	S,M,D	14%- 1%	<1% in S, highest in M, 2-6% in D.
Southwest	27	S	<1%	----------
	28	S	<1%	----------
	30	S	<1%	----------
	62	S	<1%	Poor data - water in probe
	63	S	48%-10%	No change through May; probe destroyed 6/11/86
	83	S	0	Questionable data - probe plugged
	89	S	<1%	Data 6/30 - 8/27/86
South	H	S,M,D	0	Zero in S, M&D blocked
	I	S,M,D	62%-0	Zero in S&M, no change in D (20-60%) over time

SECTION	PHASE/WELL	DEPTH	RANGE	TREND/COMMENT
	J	S,M,D	79%-0	High levels M&D, no trend
	K	S,M,D	90%-	High all 3 levels, no trend
	31	S	<1%	----------
	32	S	<1%	----------
	33	S	<1%	----------
	34	S	<1%	----------
	35	S	<1%	----------
	36	S	<1%	----------
	37	S,M,D	82%-0	<1% in S, 1% in M, 40-50% in D; no trend
	38	S	<1%	----------
	70	S	<1%	----------
	71	S	<1%	----------
	87	S,M,D	20%-0	21% in S&M; 5-20% in D; no trend
Southeast	C-5	D	40%-1%	Reduced with time
	C-6	D	18%	Only one sample (7/16/86)
	C-8	D	14%	Only one sample (7/16/86)
	C-9	D	8%	Only one sample (7/16/86)
	C-10	D	-----	No data
	39	S	60%-1%	Reduced - <1% since 4/86
	40	S	<1%	----------
	41	S	<1%	----------
	42	S	<1%	----------
	43	S	0-1%	----------
	44	S,M,D	68%-0	Highest levels in D, reduced with time

SECTION	PHASE/WELL	DEPTH	RANGE	TREND/COMMENT
	45	S,M,D	58%-0	Highest levels in M, reduced with time
	59	S,M,D	70%-0	Highest levels in M, reduced with time
	61	S	<1%	----------
	72	S	<1%	----------
	77	S	<1%	----------
	78	S	10%-0.1%	No trend; Aug. 2-3%
	81	S,M,D	100%-0	High levels all in D; reduced with time
	86	S,M	100%-0	Reith Road; high levels in M
	90	M	100%-5%	Reith Road; no trend
	91	S,M	4%-.1%	No trend
East	L	S,M,D	80%-0	High levels all 3 depths, reduced with time
	M	S,M,D	86%-0	High levels M&D, all 0 since 3/86
	N	S,M,D	56%-0	High levels all 3 depths, all 0 since 3/86
	O	S,M,D	87%-0	High levels S&M; D data poor (probe blocked) reduced with time
	E-1	D	52%-8%	Steady reduction with time
	E-2	D	42%-1%	Steady reduction with time
	C-2	D	38%-5%	Steady reduction with time
	C-3	D	50%-4%	Steady reduction with time
	C-7	D	28%-15%	Apparent reduction 7/23-8/29
	C-12	D	-------	No data
	46	S	<1%	----------

SECTION	PHASE/WELL	DEPTH	RANGE	TREND/COMMENT
	47	S	48%-.01%	<1% since 2/86
	48	S	2%-.01%	<1% since 3/86
	49	S	17%-.01%	<1% since 3/86
	50	S,M,D	82%-.01%	High levels all 3 depths; all <1% since 5/86.
	51	S	<.1%	----------
	52	S	<.1%	----------
	55	S	<.1%	----------
	56	S	48%-0	<.1% since 2/86
	58	S	<.1%	----------
	60	S	32%-.1%	<1% since 5/86
	66	S	30%-.1%	<.1% since 2/86
	73	S	<.1%	----------
	75	S	<.1%	----------
	76	S,M,D	10%-.1%	Highest levels in D; all <.1% since 3/86
	79	S,M,D	54%-0	Highest levels in D, reduced with time
	84	S,M,D	<1%	----------
	85	M,D	70%-1%	High levels 30-70% in D; no trend 7/3 to 8/25/86
Northeast	53	S	<.1%	----------
	54	S	<.1%	----------
	57	S	<.1%	----------
	80	S,M,D	2%-.01%	All <.1% since 4/86
	92	S,M	6%-.01%	No clear trend

seton, johnson & odell, inc.
consulting engineers

419 occidental south
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October 6, 1986

Virginia Galle
Seattle City Council
1110 Municipal Building
Seattle, Washington 98104

RE: Midway Landfill Draft Closure Plan
Comments on Behalf of L.I.F.E.

Dear Ms. Galle:

Seton, Johnson & Odell, Inc. is the air quality consultant member of the L.I.F.E. Technical Advisory Team. This letter presents our comments, opinions and recommendations on Sections 6 and 7 of the Draft Closure Plan dealing with gas management and post-closure monitoring. It has been prepared in consultation with Carr/Associates, the ground water and water resources member of the L.I.F.E. consultant team.

Gas Migration Control

The approach taken to the control of lateral migration of landfill gas is a common one, representing no innovation or advance in the state of the art. While this may be a positive attribute from the standpoint of applying proven technology, it does not address the problems inherent in controlling an extraction system.

Two interrelated problems must be consistently solved by the design and operation of the proposed system:

--The rate of gas migration from a landfill varies widely as barometric pressure changes; and

--The rate of gas extraction must be adjusted frequently to maximize gas removal and prevent migration while avoiding inducing excess oxygen into the refuse, creating a fire hazard.

We find nothing in the description of the intended system that indicates any control system other than periodic checking and manual adjustment of valves and dampers on individual wells. This approach will result in infrequent

adjustment of the system, and may allow any problems of excessive oxygen infiltration or inadequate methane collection to continue for a period of days before they are corrected.

There is no indication in the EIS or other documents associated with Midway that the City or its consultants ever considered air injection as an alternative technology to extraction wells as a means of migration control. This approach has been successfully applied to a number of sites elsewhere, and has successfully eliminated lateral gas migration. It is feasible wherever native soils exist around the perimeter of the site and can be used for locating wells into which high-pressure air can be injected to establish an air barrier to methane migration, without injecting oxygen into the refuse itself.

We do not know whether an air injection system is technically feasible at Midway. If it were, its installation would provide a more positive and reliable migration control system, while improving the control reliability of the odor control system. Its energy costs to operate would likely be greater, but could be offset by installation of an energy recovery system using landfill gas.

If the extraction well system is used as planned, an improved means of control should be devised to regulate the amount of gas withdrawn. Monitoring wells should be established at locations between extraction wells, to serve as indicators of adequate collection, with continuous monitoring of methane and/or static pressure as inputs to a system that modulates extraction volumes as they change with barometric pressure and other variables.

Odor Control System

The basic approach to odor control is sound. Improvements may be possible, however, in three areas: control of volumes to optimize collection and minimize oxygen infiltration into the refuse; combustion efficiency of the flare; and energy recovery.

The comments above with respect to the difficulty of achieving a balance between adequate collection of gas and minimizing the induction of oxygen into the refuse apply to the odor control system as well as the perimeter extraction wells. The City would be well served by an automated control system that modulates extraction volumes in each branch of the collection system in a way that maintains this balance.

At a minimum, the installation should include instrumentation to monitor and record on a continuous basis the basic operating parameters of the system, including methane, oxygen, CO_2 and temperature in the gas fuel to the flare.

Depending upon its design, the proposed flare to be used for incineration of landfill gas represents the most commonly applied approach, and should be capable of meeting applicable air quality standards. There is little question, however, that a higher level of control can be achieved. A fully enclosed, refractory lined combustion chamber with positive control of combustion air would achieve a more consistent level of control with minimal chance of flame loss. It would also be adaptable to energy recovery in a steam cycle system.

Until the flares are installed and tested for emissions, we will not know the extent to which an improved fume incineration system is justified. It would be appropriate, however, to develop some preliminary design and cost information at this time. If the decision is made to proceed with the flare installation at this time, the City should be prepared to evaluate the emission test data and consider an improved system if it indicates any potential hazard to the community.

One area where the Draft Closure Plan is clearly deficient is in its absence of a committment to evaluate energy recovery from landfill gas. This commitment was made in the Environmental Impact Statement (DEIS, pg. I-43), and should be restated and carried out in the Closure Plan.

There is no reason why the evaluation of energy recovery should wait until final completion of the gas system. Sufficient data is available on gas volumes and constituents from the presently installed systems to

enable an evaluation of the technical and economic aspects of recovery sufficient for decision making. There is an abundance of literature on the subject for the City and its consultants to draw on in a preliminary engineering study.

Post-Closure Plan

The monitoring program for offsite probes and extraction wells is generally appropriate. We suggest an additional refinement, however, to assure that the migration control system is functioning as intended. It has been shown that methane migration fluctuates widely in a short time span--a matter of hours--during periods when barometric pressure is changing.

Specifically, methane concentrations have been shown to increase rapidly when barometric pressure decreases. A single daily sample on a scheduled or random biweekly basis will most likely miss the peak times of such cycles. Accordingly, the sample program should include periodic (e.g. once a month at selected locations) repetitive sampling during an 8 to 12 hour period when barometric pressure is expected to decrease.

Summary--Recommendations

1. Evaluate air injection as an alternative to the perimeter extraction well system of controlling lateral migration of landfill gas.

2. If perimeter extraction wells are used, provide continuous monitoring of its performance and automatic control of its operation to assure adequate collection and minimum infiltration of oxygen into the landfill.

3. Provide continuous monitoring and recording of operating parameters for the odor control gas extraction and flare system, and automatic controls to optimize its performance.

4. Carry out a preliminary engineering evaluation of an improved combustion technology in place of the proposed flare system.

5. Meet the committment made in the Environmental Impact Statement to evaluate energy recovery by making a preliminary engineering study of its technical and economic feasibility, concurrently and consistent with the evaluation of improved combustion technology as recommended in (4) above.

6. Incorporate in the monitoring program a regular set of repetitive samples of selected wells or probes during periods of rapid downward changes in barometric pressure, to verify that the migration of methane has been prevented during the most adverse periods.

I trust these comments and recommendations will be received in the cooperative spirit in which they are intended. While they are made in carrying out our obligation to our client, our contribution to the effective solution to the problems at Midway is entirely consistent with our corporate and personal situation as residents of the City of Seattle.

Yours very truly,

F. Glen Odell, P.E.
President

cc: Jim Carr
Denny Smith
Mark Edens

APPENDIX 3C

seton, johnson & odell, inc.
consulting engineers

419 occidental south
seattle, washington 98104
(206) 624-2629

July 30, 1986

Dan Swenson
Office of Hazardous Substances and Air
Quality Control
Department of Ecology
Mail Stop PV-11
Olympia, WA 98504-8711

RE: Midway Landfill Remedial Investigation

Dear Mr. Swenson:

As the air quality consultant for the L.I.F.E. group of Midway area residents, I appreciated the opportunity to review the final work plan and sampling and analysis plans for the remedial investigation. This letter reiterates the concerns and comments I addressed in a telephone conversation with Mr. Kirk Winges of TRC and at the public meeting on July 24, 1986.

First, I would like to request an opportunity to meet personally with the appropriate technical representatives of DOE and the City of Seattle to discuss the issues presented below. A process of open discussion and interchange will assure my clients that their interests have been given full consideration in the RIFS study design.

The concerns that I believe need to be addressed are listed and discussed below.

1. In general, the air quality program appears to place excessive importance on characterizing emissions, to the detriment of directly measuring community ambient air impacts. I believe the work program relies too heavily on the development and use of a dispersion model for a problem of this sort involving a low-level source, a limited geographical area where micrometeorological influences are important and very low ambient concentrations of toxic air pollutants.

2. The exclusive use of upwind/downwind sampling techniques will fail to characterize concentrations during calm and near-calm conditions when maximum pollutant levels are likely to occur.

3. As designed, the ambient sampling program will not evaluate the potential impact of the gas extraction wells which, as we all heard at the public meeting, are a source of serious concern on the part of the residents. Some nominal ambient air sampling should be done along with the planned source testing activities.

4: Task 2.3.3.3 of the work plan suggests reliance on the dispersion model used by U. of W. researchers to determine worst case conditions for sampling and modeling. Assuming this refers to the studies done for the FEIS, I express strong reservations about use of this modeling exercise for any future work on the project. It used the most elementary of assumptions for a source configuration very different from the present situation. Future modeling work should be based on one of the more sophisticated models that are readily available and appropriate for this application.

5. The emission tests planned for the onsite gas flare system are important but will be technically difficult to accomplish. I request an opportunity to review the proposed field and analytical methodology in detail before the tests are done, and to observe the sampling activity in the field.

6. Finally, and apart from air quality technical concerns, Jim Carr and I urge the City to construct a proper security fence around the landfill site. The existence of hazardous liquid wastes, gas vents, and a plastic pipe gas extraction and flare system makes it an exceptionally hazardous piece of property. Fencing and signing as an interim control measure will reduce both the threat of serious accident or sabotage, and the possibility of legal liability resulting from such an incident.

I sincerely appreciate the cooperation that you and other members of the City and State team have extended thus far. I look forward to making a positive contribution to the RIFS process that is of such vital importance to our client group. Please let me know when it will be convenient to meet with your air quality group to discuss the issues introduced above.

Yours very truly,

F. Glen Odell, P.E.

cc: Mark Edens
Kirk Winges
Jim Carr
Peter Buck

APPENDIX 3D

ANDREA BEATTY RINIKER
Director

OCT 1986

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Mail Stop PV-11 • Olympia, Washington 98504-8711 • (206) 459-6000

October 6, 1986

Mr. Glen Odell
Seton Johnson & Odell, Inc.
419 Occidental South
Seattle, WA 98104

Dear Mr. Odell:

The purpose of this letter is to document our meeting with the City of Seattle on Monday, September 15, 1986 and to respond to your concerns raised in a July 30, 1986 letter to me.

Your concern about the lack of the ambient air quality monitoring under calm or near-calm conditions is valid. As we discussed in our meeting, the remedial investigation work plan and sampling and analysis plan will be modified to add two to three rounds of still air ambient monitoring. The sampling will be conducted with one on-site and two off-site stations. The samples will be 8 or 24-hour samples and probably will be collected during the winter months.

In addition to the still air sampling as a part of the remedial investigation, Ecology will take more ambient air samples in the neighborhoods near the extraction wells. Once we get back our latest air modeling work then we will design and implement an ambient sampling effort. Also we will coordinate this sampling with the still air sampling portion of the remedial investigation.

The air modeling work in the remedial investigation will be done with the Industrial Sources Complex model and possibly other state of the art models. Ecology's modeling work that is being done now is with Industrial Sources Complex model.

In regard to the sampling of the flares, you will be given an opportunity to review the proposed field and analytical methodology. Also, you can observe the sampling activity in the field.

Please call me if you have any questions.

Sincerely,

Dan Swenson

Dan Swenson
Hazardous Waste Cleanup Program

DS:cp

cc: Lin Robinson, Seattle

4.0 FINDINGS: WATER

4.1 ISSUES AND CONCERNS

4.1.1 Community Concerns

Community residents are concerned that leachate from Midway Landfill is contaminating the local water resources. Their concerns include possible adverse health effects resulting from exposure to surface and ground water in the area.

The L.I.F.E. team believes the limited available evidence indicates that landfill generated leachate is escaping from the site and impacting surface and ground water resources. However, the type, extent, concentration and potential health effects of the contaminants is not presently known.

The concern for intake of contaminants through public water supply systems is reduced by the fact that there are no known water supply wells near the landfill. However, concerns for the risks associated with contact exposures to surface water and the long-term damage to ground water resources are justified.

Precise definition of Midway's water resource problem is long overdue and must be addressed immediately. Findings resulting from a comprehensive and accurate investigation must be the basis for remediation of the identified problems.

4.1.2 Definitions

The following technical terms are used in this section:

Leachate - Water which has been altered by its contact with refuse.

Infiltration - The movement of water (precipitation) through surface sediments or refuse above the uppermost aquifer.

Runoff - Accumulated precipitation which leaves the landfill site in a defined course.

Runon - Accumulated precipitation which enters the landfill site.

Aquifer - A permeable water-bearing unit capable of providing samples for examination and analysis.

Specific Conductance - A measure of water's ability to transmit electrical current. The value is directly related to the concentration and charge of the ions present and therefore is often a suitable indicator of the presence of contaminants.

Tightline - A pipeline without leaks.

4.1.3 Overview of Water Resource Issues

Because of the Midway Landfill's hydrogeologic setting and the type of wastes buried in this old gravel pit, environmental impacts on the area's water resources are unavoidable. Direct precipitation on the site averages about 40 inches annually. Some of this water is evaporated and transpired while approximately 20 inches either runs off or infiltrates. Runoff from the east side of the freeway is also added to the landfill site indirectly through a culvert system which directs water beneath I-5 and into the Midway wastes at depth.

When infiltrated precipitation and runon contact waste materials in the fill, components of the waste are dissolved creating leachate and landfill gas. As infiltration and runon continue to enter the landfill, leachate migrates down gradient away from the site.

At Midway, leachate moves away from site easily because of the high permeability of the natural sands and gravels in which the wastes were originally placed. The L.I.F.E. team believes that local ground water moves radially away from the Midway site, as well as downward toward underlying aquifers. Down gradient movement of leachate has altered water quality of local surface and ground water, and will continue to do so until leachate generation is stopped and its migration away from the site is curtailed.

The degree of alteration of surface and ground water is determined by the solubility and transportability of waste materials in water and in the leachate. The concentration of contaminants at down gradient surface and ground water sampling locations depends on proximity to the Landfill, the position relative to leachate plumes (which exist but have not been properly identified) and on natural attenuation soils, bacteria or other media acting on the leachate.

4.2 EVALUATION OF DATA

The water resource data considered here includes:

* Geologic data from descriptive well logs and samples

* Hydrologic data from measured water levels, elevations, discharge measurements

* Water quality data from analyses of water and leachate samples

4.2.1 Data Availability

The City of Seattle's Solid Waste Utility provided most of the data and information used in this review. The L.I.F.E. team requested all available data and presumably received the complete set of landfill water resource data. However, because the City has neither developed a comprehensive data base nor maintained a listing of water level measurements and sampling/analytical activities, we cannot be certain that our review included all the data.

Additional water quality data was provided by DOE. The DOE's analytical efforts have focused on sampling of streams and discharges located primarily west of the landfill.

4.2.2 Sampling Activities to Date

Table 4-1 lists 26 data sets of available water analyses. These reports, from 1982 through October 1986, represent analyses of samples from on-site monitoring wells, ponds, Smith Creek, leachate, springs, streams and other surface water sources.

The analytical parameters provided by each analyses are categorized in Table 4-1 as: A - Physical Parameters; B - Inorganics and Metals and C - Priority Pollutants. The components of each category are listed in Table 4-2.

4.2.3 Adequacy and Accuracy

The data summary shown in Table 4-1, indicates that the generation of water quality data has been sporadic in both time and space. Monitoring wells were sampled regularly during 1983, but apparently on-site sampling was then discontinued. More recent analyses (1985, 1986) emphasize surface waters west of the landfill.

It should also be noted that analyses for inorganics and metals (Category B listed in Table 4-2) are typically incomplete and inconsistent. Analyses of potentially significant metals are not reported on many of the analyses.

Meaningful interpretation of water quality data requires repetitious and regular (at least quarterly) analysis of samples from specified locations for specified parameters. Analytical standards must be established and repeated for each set of samples. Duplicates and split samples should be prepared for analyses by other qualified laboratories using identical methods.

We understand that followup water level measurements and sampling from some on-site monitoring wells was not possible because of difficulties with the well structures. For example,

on-site settlement and high in-waste temperature apparently has caused PVC well casings to fail, curtailing any additional sampling or sounding.

4.2.4 Interpretation of Data

The L.I.F.E. team's interpretation of hydrogeologic and water quality data is substantially different from that of the City's consultants. Our interpretation of the water level data presented in the Closure Plan Draft EIS shows that a ground water mound is present beneath Midway. The presence of this ground water mound means that leachate leaves the landfill in all directions, not simply to the south as described in the EIS.

Figure 4-A in Appendix 4A of this report compares this interpretation of ground water movement to that presented in the Final EIS. Because the water level data represents conditions in multiple aquifer zones, we expect new data may refine the shape and location of the mound. However, it is unlikely that any new data would allow definition of a southward ground water migration.

The movement of ground water and leachate radially away from the landfill is even reflected in the sparse water quality data. Specific conductance values listed in Table 4-3 are well above background. Figure 4-1 illustrates these values at each sample location and suggests that significant amounts of leachate discharge to the west and northwest. The absence of high specific conductance values in other directions (east and south) is most likely a result of limited sampling in those areas.

Limited analyses for volatile and semi-volatile priority pollutants also shows migration of these contaminants away from the landfill. Table 4-4 identifies the type of priority pollutant and lists those sites where the contaminants have been identified. As shown in Figure 4-2, these compounds have been found primarily on the landfill's west side.

To date, analyses for priority pollutants has been so limited that the map pattern shown probably does not reflect the actual distribution. It is also possible that sources other than the landfill could contribute to the priority pollutants present. Future investigations should include identification and remediation of all such sources.

4.2.5 Alternative Interpretations

Sampling and analyses of surface and ground water has been so limited that evaluation of the potential impacts is difficult. However, any interpretation that used the lack of evidence resulting from these incomplete sampling programs to suggest the absence of contaminants in the local water resources would be in error. In addition, continuing to defer water resource remedial actions could allow contaminant migration to expand creating increasingly difficult and more costly restoration programs.

On the other hand, the community should not assume that the City's reluctance to carry out a thorough sampling program necessarily indicates that a serious health risk exists for everyone in contact with the local water resources.

4.3 ADEQUACY OF PLANNED ACTIONS

4.3.1 Closure Plan

The L.I.F.E. team examined the Draft Closure Plan dated September 1986 and submitted comments and recommendations to the Seattle City Council (Appendix 4A). This section summarizes the recommendations.

The general concept proposed by the Draft Closure Plan should help resolve many of the problems at the Midway site. As the plan suggests, the most critical needs are to eliminate surface water runon, upgrade gas control systems and properly cover the site. However, nearly every segment of the plan lacks sufficient detail to allow evaluation of the proposed actions.

1. Stopping all surface water runon to the dump is critical. This must include permanent closure of the existing overflow drain from the east side of I-5. Disposal of all collected water through tightline routes is most appropriate.

2. The Closure Plan provides no information on the leachate collection and disposal systems. Leachate extraction wells should be included as part of the leachate control plan.

3. The Final Grading Plan must be designed to prevent on-site runoff from escaping the control system. The proposed grade of the site shown in Figure 2-1 of the Draft Closure Plan would allow surface runoff from the landfill and leachate from relatively shallow refuse to:

   * Overwhelm the leachate collection system on the north and west sides of the landfill

   * Enter the proposed detention basins at the north end of the property

   * Enter open surface drainages on the west and south sides of the landfill

   * Exit the property flowing eastward along the east side of the property adjacent to I-5.

4. The Final Cover System must prevent mixing of leachate and surface water and must provide a suitable evacuation system for landfill gas.

5. All remedial actions which have a reasonable (50% or greater) chance of being included in any final RA plan should be implemented now. Waiting until late 1988 will allow degradation to advance, resulting in greater damage and higher cleanup costs.

4.3.2 Evaluation of RI/FS

The L.I.F.E. team's earlier comments on the RI/FS focused on air quality at the site. The comments below address the water resource plans described in the RI/FS.

Specific water resource elements of the RI which need to be improved are related to monitoring well installation, ground water and surface water monitoring and the projected timing and scheduling of the work.

Monitoring Well Installation

1. The RI does not describe the disposal of contaminated cuttings or water removed during drilling of the monitoring and leachate collection wells. Some materials may be suitable for disposal in the landfill, but potentially hazardous wastes should not be returned to the Midway site.

2. Wells should be installed using cable-tool drilling equipment unless air-rotary drills are equipped with cyclone separators to collect all emissions. It is unlikely that hollow-stem auger (HSA) drills would be effective in drilling the hard tills at the site. In addition, placement of effective seals between zones in HSA drilled wells is virtually impossible.

3. Seals between zones should be made with expanding grout or other sealant capable of performing as needed. Bentonite and bentonite-grout seals are permeable to some organic compounds. Subsidence and movement in the landfill preclude use of rigid neat grout seals (Ref. 4-1).

4. The likelihood of subsidence and movement of the landfill should be addressed by the design of all on-site monitoring wells and leachate wells. Such design requirements include extensive overlap of casings or expansion joints and preclude the use of PVC or other types of plastic casings.

5. Because of the character of the leachate, including the presence of organic contaminants and metals, the proper material for permanent well casings and screens is 304 or 316 stainless steel (Ref. 4-2).

6. Installation of "Ground Flush Locking Monument Cases" (Figure 4 - Sampling and Analysis Plan - SAP) is ill-advised. This configuration may be convenient for site preparation, but does not provide adequate protection from direct entry of surface contaminants.

7. Figure 5 (SAP) shows a typical leachate well completed with 2 to 4-inch steel casing. Page 6 of the SAP indicates that the leachate wells will be completed with 5 or 6-inch steel casing. These wells should be completed with 6-inch or larger diameter casing to accommodate the pumping and monitoring equipment.

8. The proposed depth of the screened intervals is not provided in SAP Table 1 as stated in Section 2.2.1.3 (SAP). The length of the screened interval is critical to subsequent evaluation of water level and water quality data. Long screened sections can dilute concentrations of contaminants that are frequently confined to relatively thin horizons. Excessively short screens can miss the critical zones.

9. No discussion is provided regarding sampling and analysis of soil samples collected during drilling of monitoring wells. Analyses (similar to those for surface soils described in Table 6 SAP) of properly collected samples is needed to evaluate the sorptive characteristics of the soils.

Ground and Surface Water Monitoring

1. Water levels in at least 10 monitoring wells should be measured weekly for 3 to 6 months following installation. Continuous water level recorders should be installed and maintained for at least one year at one on-site well and one off-site well. These data are needed for evaluation of hydrologic relationships between aquifers and the responsiveness of discrete horizons.

2. The SAP proposes use of bladder pumps for collection of water samples. Substitution with the new stainless-steel piston-type pumps should provide more reliable samples. Sampling pump cleanup procedures (and other critical QA/QC plans) are not provided in the RI/FS documents.

3. The sampling plan should be revised to insure that at least one complete set of water quality samples are collected during each quarter (season) of the year. Samples collected immediately following well completion will likely have elevated concentrations of important contaminants. The concentration of contaminants in subsequent samplings is expected to vary seasonally. Terminating collection from any source (well or surface water) because one data set lacks significant contaminants is technically indefensible.

4. Specific sampling and analytical improvements include adding:

   * Analyses for total organic carbon (TOC) and total organic halogens (TOX) to all surface and ground water samples

   * Determination of PCB compounds and dioxins in all leachate and on-site sample analyses

* Analyses for all potential leachate components to runoff samples collected during storm (heavy precipitation) events

5. On-site meteorological data should be used to develop a water budget. The water surplus derived from the water budget should be compared to the measured runoff and estimated infiltration quantities.

6. Measurement of the eastside discharge (runon) should not delay installation of the diversion systems. Installation of a totalizing meter at the eastside pumping station would provide accurate discharge data.

Timing and Scheduling

1. Figure 3-1, the RI Work Plan Schedule, shows completion of field activities at 34 weeks after notice to proceed (NTP) and completion of RI after 52 weeks. The L.I.F.E. team believes this schedule is not realistic and cannot be met.

2. None of the RI tasks should be abandoned in order to meet the projected schedule.

3. Additional tasks and improvements described in this review could require more time.

4. Installation of 17 monitoring wells will require about 300 rig days. Installation of 3 leachate wells will require about 30 rig days.

5. The most optimistic completion time using multiple rigs is about 34 weeks.

6. Delays caused by weather, difficult completion and drilling conditions, equipment breakdowns and the necessity for crews drilling in hazardous wastes to use cumbersome safety apparatus could easily double the time required.

7. Figure 4-3 illustrates a more likely schedule for the surface and ground water tasks described in the Work Plan.

8. Even if the monitoring well installation schedule shown in the Work Plan's Figure 3-1 could be met, monitoring and quarterly sampling could not be completed for at least 1 1/2 years after NTP.

9. Since completion of the RI could take 1 1/2 years, all reasonable interim remedial actions should be evaluated and implemented as soon as possible.

10. The SAP emphasizes reducing the sampling and analysis programs based on early results. It is more likely that new representative data from the first 10 monitoring wells and the leachate wells will require expansion of the SAP.

4.4 CONCLUSIONS

The conclusions listed below summarize the important characteristics of prior and proposed work at the site.

1. Accurate water level and water quality data for the Midway area is very sparse and has been largely misinterpreted in prior studies.

2. Available data indicates that water (leachate) levels at the landfill site are the highest in the area. This allows leachate to move away from the site in virtually all directions.

3. Available water quality analyses show that the area's surface and ground waters have been impacted by landfill leachate.

4. The activities described in the Draft Closure Plan are generally consistent with good landfill practice and should reduce the impacts on local water resources. However, the Plan's lack of detail requires a high level of community trust, which may not be warranted.

5. The planned activities of the RI/FS should provide much needed additional water resource data. However, the program has deficiencies which need to be corrected.

4.5 RECOMMENDATIONS

The recommendations listed below summarize the improvements, modifications and changes needed for accurate understanding and effective remedial actions to restore the quality of Midway's water resources.

The City of Seattle should:

1. Create a relational data base to record all samples and analyses collected as a part of the Midway investigations.

2. Use the data base with compatible systems to produce maps showing areal distribution and trends of contaminants.

3. Modify the Closure Plan to include: permanent elimination of all eastside runon, an operational leachate collection/ treatment/disposal system and descriptions of essential details for liners, pump stations and other items described in this report.

4. Incorporate the changes to the RI/FS presented here including:

   * Modification of monitoring well design

   * Expansion of monitoring well sites (if needed)

* Sampling all sites quarterly for at least one year

* Expansion of analytical parameters beyond "indicators"

* Sampling of runoff during storm events

5. Avoid sacrificing RI tasks to meet the unrealistic schedule.

6. Implement, as soon as possible, all reasonable remedial actions which will likely be a part of final actions.

Because of the limited amount of good data available for this review, and the many analyses and evaluations that are expected in the near future, the City should provide L.I.F.E. with additional funding for the technical advisory team. Appropriate water resource activities for the TAT include:

1. Providing independent evaluation and recommendations for improvement of the monitoring well and surface water analytical data as it becomes available.

2. Assisting with site selection of Phase II monitoring wells and additional wells required to define probable leachate plumes.

3. Reviewing selected analytical parameters and the significance of "indicators."

4. Cooperating with City representatives to develop appropriate data base, graphic and ground water model systems.

Table 4-1

Available Water Analysis

Midway Landfill

Sample Date	Sample Location	Sample Type (2)	Category of Analysis (1) (A) Physical Properties	(B) Inorganics and Metals	(C) Priority Pollutants	Sampling Agency	Testing Lab (3)
02-22-82	MW (4)	GW	A	-	-	Seattle	Golder
01-06-83	MW, Ponds	GW, SW	A	B	C	DOE	REL
01-06-83	MW	GW	A	-	-	EPA	E&E
04-19-83	Ponds	SW	A	B	-	DOE	REL
05-05-83	Ponds	SW	-	B	C	EPA	EPA
05-31-83	Smith Creek	SW	A	B	-	DOE	REL
06-13-83	Ponds	SW	A	B	-	DOE	REL
06-15-83	MW	GW	A	-	-	EPA	E&E
06-16-83	MW	GW	A	B	C	DOE	REL
08-12-83	MW	GW	A	B	-	DOE	REL
04-23-84	Leachate	SW	A	B	-	Seattle	FT
04-26 to 06-19-84	Ponds	SW	A	-	-	Seattle	FT
05-17-85	MW, Ponds	GW, SW	A	B	C	Seattle	ATI
06-05-85	Leachate	SW	A	B	C	Seattle	ATI
07-10-85	MW	GW	A	B	C	Seattle	ATI
07-10-85	Reith Rd. Spring	SW	A	B	C	Seattle	ATI
09-23-85	Parkside Area	SW	A	-	-	DOE	DOE
10-14-85	Parkside Area	SW	A	B	-	DOE	Laucks
01-23-86	Parkside Area	SW	A	-	-	DOE	DOE
01-24-86	Parkside Area	SW	A	-	-	DOE	DOE
01-30-86	Parkside Area	GW, SW	A	-	-	DOE	DOE
02-06-86	Smith Creek	SW	A	-	-	DOE	DOE
02-12-86	Parkside Area	GW, SW	A	-	-	DOE	DOE
04-15-86	MW	GW	A	B	C	DOE	DOE
04-15-86	Local SW	SW	-	-	C	DOE	AR
10-00-86	Parkside Area	S	-	B	-	DOE	DOE

(1) Category of Analysis: See Table 4-2
(2) Sample Type: S = Soil, GW = Ground Water, SW = Surface Water
(3) Testing Laboratory: See Table 4-2
(4) Sample Location: MW = Midway Landfill Monitoring Wells

Table 4-2

Components of Table 4-1 Categories

Category of Analysis (1)

A. Physical Properties

Specific Conductivity
pH
Temperature
Turbidity
Total Solids
COD - Chemical Oxygen Demand
BOD - Biological Oxygen Demand
Fecal Coliform Bacteria
TOC - Total Organic Carbon
Total Hardness

B. Inorganics and Metals *

As, Arsenic
Ba, Barium
Cd, Cadmium
Cr, Chromium
Fe, Iron
Pb, Lead
Mn, Manganese
Hg, Mercury
Se, Selenium
Ag, Silver
F, Fluoride
Na, Sodium
Cl, Chloride
Cu, Copper
Zn, Zinc
Ni, Nickel
K, Potassium
Cn, Cyanide
NO3, Nitrate
SO4, Sulfate
Boron

C. Priority Pollutants

Inorganics
Base Neutrals
Volatiles

* Typical Midway analyses include only selected items from these Category B analyses

Testing Laboratories (3)

REL, Redmond Environmental Laboratory
E&E, Ecology and Environment, Inc.
FT, Federal Testing
ATI, Analytical Technologies, Inc.
DOE, Department of Ecology (Washington State)
EPA, Environmental Protection Agency (U.S.)
AR, Analytical Resources
Golder, Golder Associates (Field Analysis)
Laucks, Laucks Testing Laboratories, Inc.

Table 4-3

Specific Conductance
of Surface Water and Shallow Ground Water
at Midway Landfill

Sample Date	Sample Location	Range of Specific Conductance umhos/cm		
		200 - 399	400 - 600	> 600
06-13-83	South Pond			2200
	Middle Pond			710
	North Pond	234		
06-16-83	Well 1B			940
	Well 6			2800
	Well 8			2700
07-10-85	Reith Rd. Spring	220		
09-23-85	Parkside School		500	
	" "		500	
	" "		550	
	" "		500	
	Harvey Grohs Pond		500	
	Culvert SR99		500	
	SR99 at Landfill		450	
	Wetland by Dahl's		450	
	Dan Zeisel's		450	
01-23-86	Probe 25	290		
	Probe 18	375		
01-24-86	Swamp between 246th & 248th			
	" "	200		
	" "	370		
	" "	310		
	" "	250		
	" "	330		
01-30-86	Harvey's Dive Shop	260		
02-12-86	Probe 9	300		
	Probe 10		500	
	Probe 7	315		
	Probe R-2	335		
	Probe 17		430	
	Probe R-1	350		
04-15-86	Les Schwab Tires	225		
	20th & 250th	300		
	Peterson/Dwyer	215		

Table 4-4

Priority Pollutants
of Surface Water and Shallow Ground Water
at Midway Landfill

Sample Date	Sample Location	Priority Pollutants	
		Volatiles	Semi-Volatiles
05-17-86	MW-1	X	N/D*
	BH-6	X	X
	BH-8	X	N/D
04-15-86	Probe 10	X	X
	Les Schwab Tires	X	X
07-10-86	Reith Rd. Spring	X	X
07-23-86	24443 25th Ave. SE	X	N/D

* N/D = None Detected

Volatiles Detected

Chloroethane
Acetone
1,1-Dichloroethane
trans-1,2-Dichloroethene
Trichloroethene
Benzene
2-Hexanone
Chlorobenzene
1,1,1-Trichloroethane
Tetrachloroethene
Toluene
Ethylbenzene
Total Xylenes
Methylene Chloride

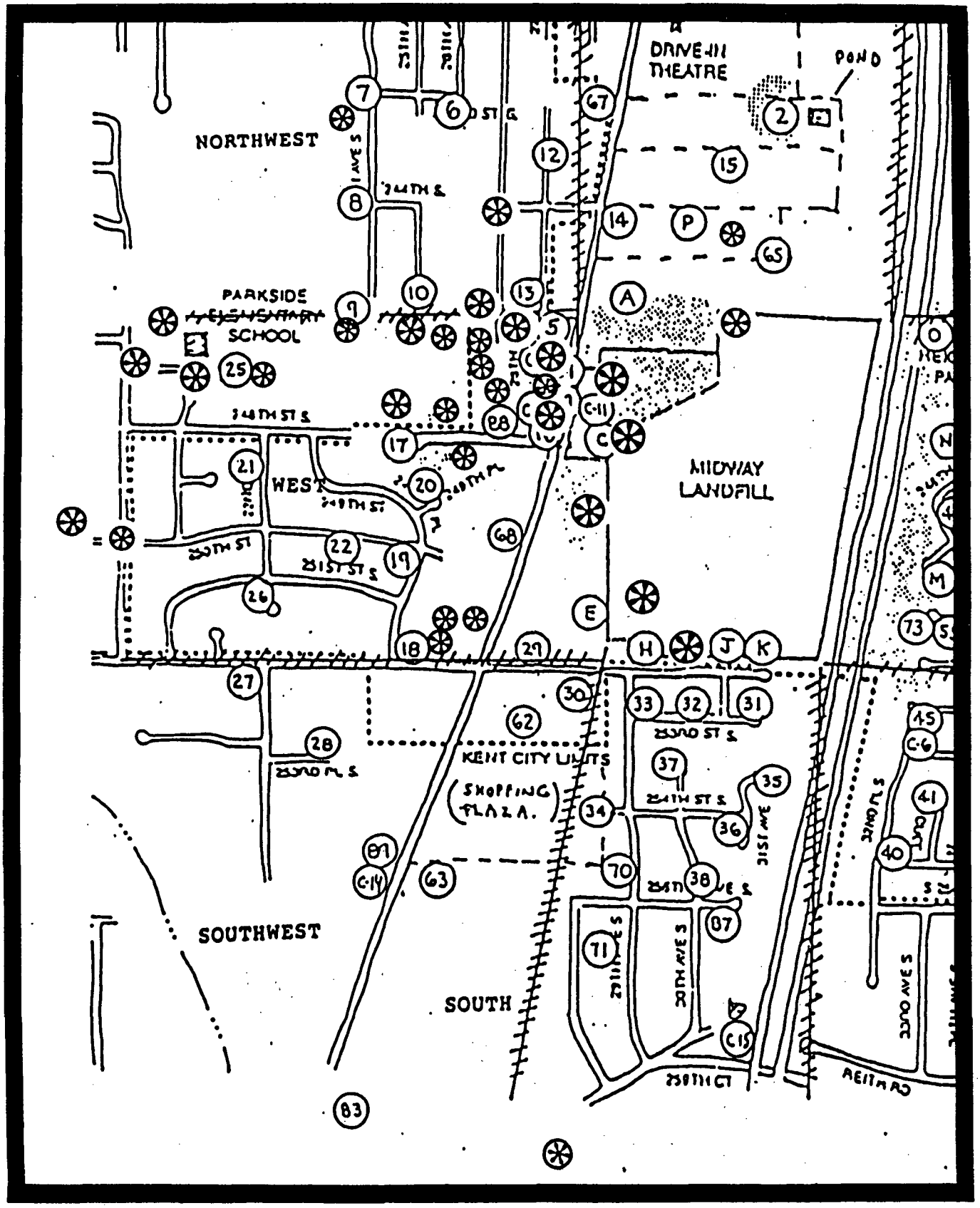
Semi-Volatiles Detected

Naphthalene
2-Methylnapthalene
bis(2-Ethylhexyl) Phthalate

SPECIFIC CONDUCTANCE

FIGURE 4 - 1

SURFACE WATER / SHALLOW GROUND WATER



- ⊛ 200 - 399 UMHOS/CM
- ⊛ 400 - 600 UMHOS/CM
- ⊛ GREATER THAN 600 UMHOS/CM

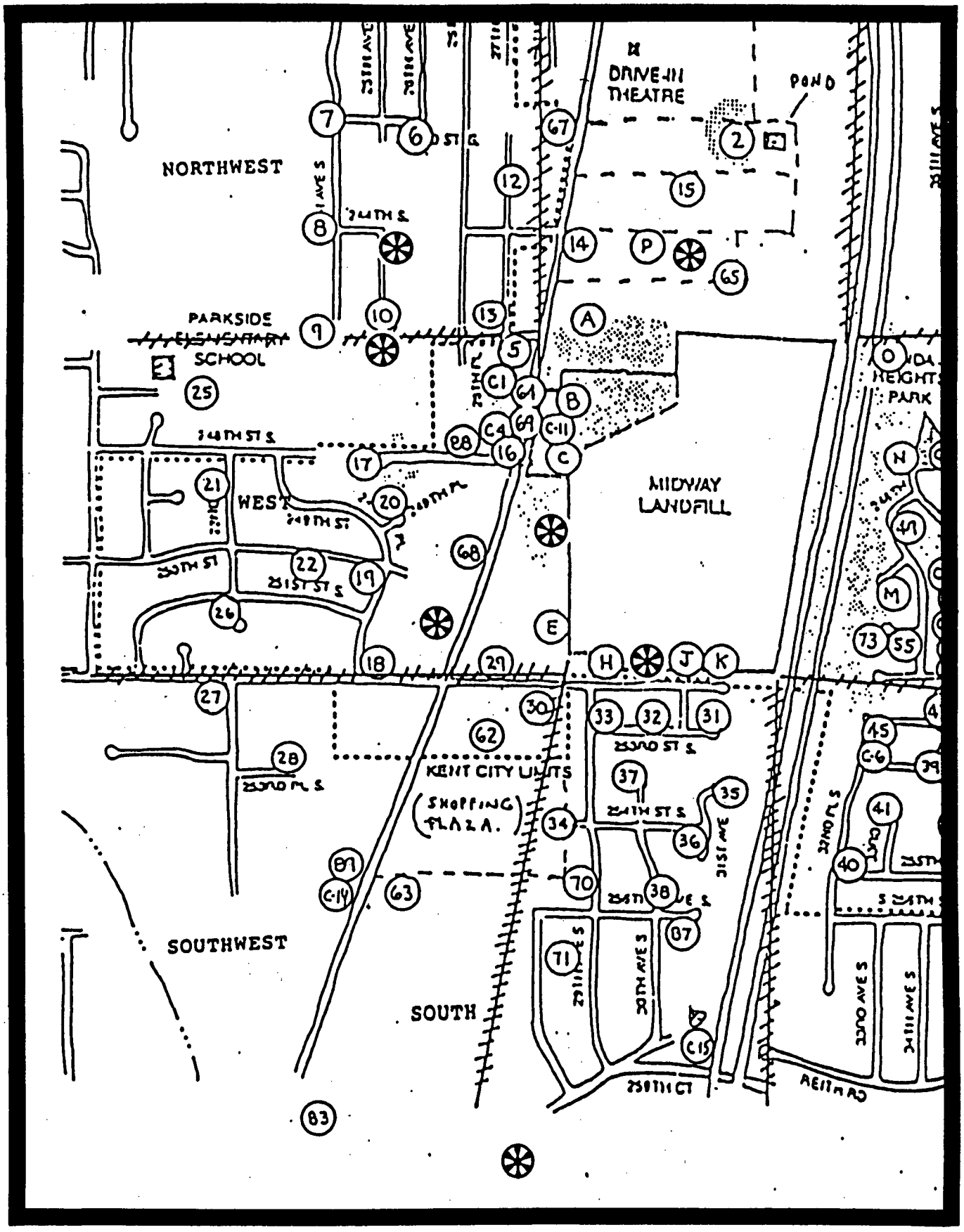
PREPARED BY:

L.I.F.E./T.A.T. 10/86

PRIORITY POLLUTANTS

FIGURE 4 - 2

SURFACE WATER / GROUND WATER

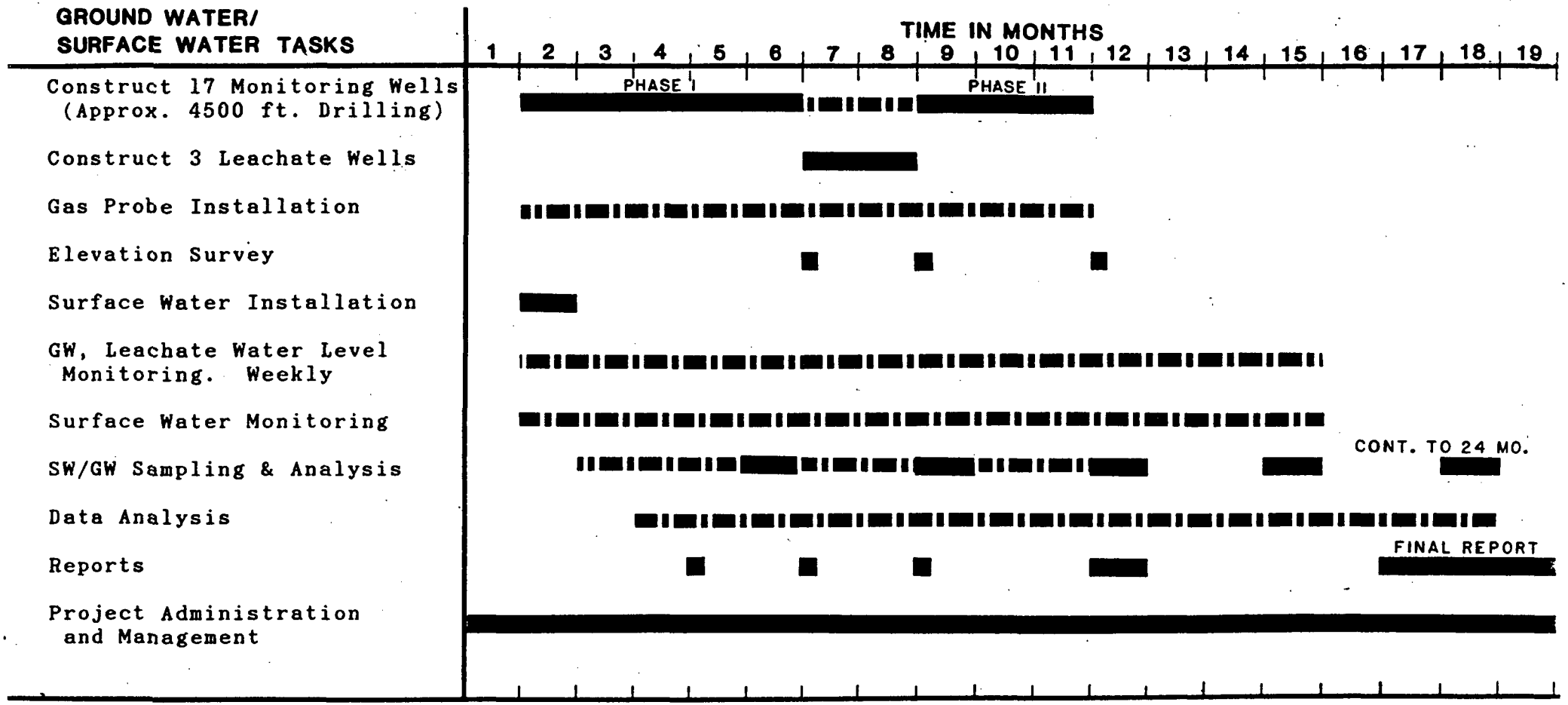


SURFACE WATER/GROUND WATER LOCATIONS

PREPARED BY:
L.I.F.E./T.A.T. 10/86

PROBABLE SCHEDULE

MIDWAY LANDFILL



CONTINUOUS WORK

INTERMITTENT WORK

PREPARED BY: L.I.F.E./T.A.T. 10/86

FIGURE 4 - 3

APPENDIX 4A

CARR/ASSOCIATES
CONSULTING HYDROGEOLOGISTS

October 6, 1986

Seattle City Council
1110 Municipal Building
Seattle, WA 98104

Attention: Virginia Galle

Subject: Midway Landfill Draft Closure Plan Comments

Dear Ms. Galle:

Enclosed are our comments and professional opinions on the September 1986 Midway Landfill Draft Closure Plan. Our firm is the ground water and water resource member of LIFE's Technical Advisory Team.

In this capacity, we have reviewed not only the Draft Closure Plan but numerous related reports, documents and technical data which have been provided to us by the City and DOE. Members of our team have held technical meetings with City and DOE staff, and received an extensive tour of the Midway site conducted by Mark Eden. We have also attended several public meetings and hearings,. including the September 23, 1986 hearing at Parkside Elementary which you chaired.

We plan to present all of our findings to date in a report to LIFE on or before October 20, 1986. I am sure that the LIFE organization plans to release our findings to the City.

With this background, we offer the attached comments regarding the Draft Closure Plan. If you or members of your committee or staff have questions regarding our comments, please call at your convenience.

Sincerely,

James R. Carr

enclosure/cc

P.O. BOX 1158
GIG HARBOR, WA 98335
(206) 851-5562

COMMENTS BY CARR/ASSOCIATES

ON THE

MIDWAY LANDFILL DRAFT CLOSURE PLAN

September, 1986

1.0 GENERAL COMMENTS

1.1 The Council faces a very difficult task in adopting a Midway Landfill Closure Plan which will safeguard public health and protect the natural environment. In the past, poor management practices at the site included:

* Improper siting (in permeable sand and gravel)
* Acceptance of pustrescible wastes for disposal
* Acceptance of potentially hazardous wastes
* Improper handling of wastes and facility (lack of daily cover, inadequate compaction, excess surface water runon)

All these factors contribute to the complexity and cost of formulating and implementing an adequate plan for closure of this landfill.

1.2 The general concept proposed by the Closure Plan should help resolve many of the problems at the Midway site. As the plan suggests, the most critical needs are to reduce surface infiltration, eliminate surface water runon, upgrade gas control systems and properly cover the site. However, nearly every segment of the plan lacks sufficient detail to

allow evaluation of the proposed actions. We appreciate that full details may not be practical in view of the City's need to leave alternate paths open. However, the lack of detailed information is responsible for some of the public misinterpretation and opposition to the plan.

Ultimately, solutions must be based on sound technical information rather than political expediency or economic short cuts. The appeal of plans with lower initial costs will fade with the realization of their greater long-term costs to the City.

1.3 A clear relationship between this Plan and the RI/FS is important. To avoid possible oversight and duplication, the City should strive to define this relationship immediately.

Based on the information currently available, it appears that many of the actions which should be or should have been part of the Closure Plan and earlier investigations have been deferred to the RI/FS. Even if the RI/FS program stays on schedule (which seems unlikely), Remedial Actions (RA) would not be undertaken until late 1988 (pages 1-9).

We suggest that the adopted Closure Plan call for implementation of all remedial actions which have a reasonable (50% or greater) chance of being included in any final RA plan. Postponing reasonable actions will allow degradation to advance, resulting in greater damage and higher clean-up costs.

2.0 FINAL GRADING PLAN

2.1 The proposed grade of the site shown in Figure 2-1 will allow surface runoff from the landfill and leachate from relatively shallow refuse to:

* Overwhelm the leachate collection system on the north and west sides of the landfill
* Enter the proposed detention basins at the north end of the property
* Enter open surface drainages on the west and south sides of the landfill
* Exit the property flowing eastward along the east side of the property adjacent to I-5.

Recommendation: Grade east and west sides of the landfill to prevent on-site runoff from escaping the control system.

2.2 The Final Grading Plan calls for the existing overflow, which directs surface water from the east side of I-5 directly into the refuse, to be "retained for emergencies." The excess water from the overflow is the source of much of the leachate and a major contributor to the generation of landfill gas (LFG) at the site.

Recommendation: Get rid of this overflow! There is nowhere this surface water can do more environmental damage than allowing it to continue to enter the landfill, even in emergencies. (See comment 5.4 below.)

2.3 The topographic relationship between the landfill, the proposed detention pond, the on-site surface water system and the leachate collection system is unclear.

Recommendation: Define these relationships prior to implementation.

3.0 LEACHATE MANAGEMENT SYSTEM

3.1 Control of leachate generated from surface water runon is briefly discussed above in section 2.2. Other elements of the leachate system are discussed in sections 4.0 and 5.0.

3.2 Specific conceptual plans for the leachate collection system are missing. The Draft EIS (Table A) suggests daily hauling of 1400 gallons (25% of 2 mg/yr) of leachate to Kent Highlands, but the system for collecting and transporting this leachate is not defined. While construction details are not expected at this point, it is impossible to evaluate the proposed system without such design basics as: depth of trench, diameter and depth of collectors, barrier membranes, filtrate and backfill characteristics; location, type and design of leachate collection; pump and transfer stations; and method of transfer such as truck, pipeline or other means.

Recommendation: Present the conceptual plans for the leachate collection and disposal system.

4.0 FINAL COVER SYSTEM

4.1 The adequacy of the final cover design, as shown in Figure 4-1, cannot be evaluated because the drawing has no vertical scale or indication of vertical exaggeration. Captions on the drawing describe the depicted side slope as: "25%

Maximum, 5% Preferred, 2% Minimum," whereas 25% is the intended side slope given on page 2-1.

Recommendation: Provide additional details or vertical exaggeration for Figure 4-1, including the actual intended landfill side slope for surfaces sloping toward drainage ditches and the leachate collection system.

4.2 If drainage ditches are left open and unlined as shown in Figure 4-1, uncontaminated infiltrated precipitation could enter the leachate collection system and greatly increase the volume of fluid that needs to be transported off site. Also depending on the position of water levels in the waste, leachate could migrate into the open ditches.

Recommendation: Provide a geomembrane liner, tightline or cover for drainage courses (ditches) to minimize areas of open water across the site. All courses for uncontaminated infiltrated water should be kept a minimum of 20 feet above the water (leachate) levels in the waste.

4.3 As described on page 2-1 of the Plan, up to 15% settlement of the wastes is expected to occur on the site during the first 5 to 10 years after closure. The areas and amount of settlement over the site could be expected to occur in random fashion. Settlement events can be expected to interrupt the continuity of the proposed 4-inch thick "amended soil barrier," which would then allow precipitation to enter the refuse or leachate to escape to the surface drainages.

Recommendation: Increase the thickness of the amended soil barrier to at least one foot, and consider increased use of impermeable geomembranes during construction and as permanent barriers. Planning should also include systems for restoring the integrity of the soil or synthetic barriers as settlement progresses.

4.4 If the amended soil barrier is effective in retarding infiltration, it will also act as a trap to the upward migration of landfill gas.

Recommendation: Add landfill gas extraction vents to layers beneath soil barrier.

4.5 Increasing the thickness of the soil barrier (and other layers) will aid in maintenance, but add to the costs of material and its placement. Placement of the cover could proceed more rapidly if synthetic membranes were used throughout or as interim cover during weather induced stoppages.

Recommendation: Consider using synthetic membranes as temporary and permanent (repairable) impermeable barriers combined with thicker soil barriers.

4.6 Figure 4-1 also shows "containment dike of compacted till on the north side with on-site detention only." We are not familiar with any prior reference to this proposed dike, but any effective means of curtailing movement of leachate away from the waste, particularly toward the detention pond, are

essential.

Recommendation: The system would be more effective if an impermeable liner were placed on the waste and the compacted till dike placed above the maximum height of saturation of the refuse.

5.0 SURFACE WATER MANAGEMENT PLAN

5.1 Stopping all surface water runon to the dump is critical. The problem is not difficult technically, but apparently has numerous jurisdictional obstacles.

Recommendation: The City should determine the best technical solution, then work to convince other jurisdictions of the merit of that plan.

5.2 The detention pond is the heart of any surface water management plan. The Midway ponds must be constructed to preclude entry of all landfill leachate and to prevent leakage. The ponds must be oversized and fully lined with suitable materials that will maintain their integrity for years.

Recommendation: Consider increasing the west pond size by 50%, to 9 acres, and installing a layered liner system beneath the entire ponded area. Position the pond topographically so that its waters can not be invaded by leachate.

5.3 The collection system east of I-5 and the transfer system to the west detention pond seems very complex for the intended purpose. Piping and pumping requirements would be greatly reduced if a direct crossing was installed between the east and west detention basins. If it is mandatory that runoff be pumped to the south, then all water, particularly that flowing north through or along the east side of the landfill, must be in a tight pipeline. This line must be located off the landfill surface to avoid potential damage from settlement.

Recommendation: Negotiate with the DOT for an I-5 crossing which passes directly between the two detention basins. Failing successful negotiations, tightline all runoff along right-of-ways outside the landfill surface.

5.4 The Plan calls for retaining the existing surface water overflow from the east side of I-5 for emergencies (Figure 5-1). This provision is technically indefensible and would negate the positive intent of eliminating surface water runon.

Recommendation: Permanently close the existing drain from the east side of I-5 by pressure grouting the line beneath the landfill and the freeway.

5.5 The Plan's recommendation to dispose of detention pond runoff down the west side through storm drains, wetlands, open ditches, culverts, ponds, Smith Creek and wetlands to Puget Sound could have some unexpected impacts. It appears

likely that landfill leachate currently migrates radially including westward (see Figure A). Springs, seeps and wetlands on the west side show degradation by landfill leachate. Storm drains installed through these areas could be expected to collect and remove any leachate present and pass it downstream toward Puget Sound.

Recommendations: Re-examine potential impacts of west side discharge route. Evaluate other tightline disposal paths, including tightline discharge to Kent-Highlands.

6.0 LANDFILL GAS MANAGEMENT PLAN

Comments regarding the Plan's provisions for landfill gas are contained in the October 3, 1986 letter from team member Glen Odell of Seton, Johnson and Odell, Inc. To those comments we add the following regarding the design of existing and proposed gas probes.

6.1 The gas probes shown in Figure 6-2 are constructed of very small diameter (1/2 to 3/4 inch) PVC and completed with long slotted intake sections. The diameter and breakable plastic materials of these probes make installation difficult, particularly during cold weather. If long slotted sections are successfully placed in the intended zones, the extracted samples are not likely to provide accurate indications of actual concentrations of the landfill gas components. Slotted portions in uncontaminated zones dilute the samples with air. Also, in extractions wells or areas of negative pressure, long slotted lengths provide a

pathway for air to enter the landfill. Induced air creates combustion of the refuse which melts PVC gas probes and similar installations. It is significant that carbon dioxide (a product of combustion) has been measured in on-site probes and that many on-site probes and monitoring wells are not usable because they have collapsed or melted.

Recommendation: Install 1-inch or larger diameter gas probes constructed of 18-8 stainless steel. Slotted or screened sections should not exceed 3 feet in length.

7.0 POST CLOSURE PLAN

7.1 The proposed preparation of a Post Closure Operation and Maintenance Manual (Table 7-1) is commendable. However, an element describing operation and maintenance of the leachate collection system was omitted.

Recommendation: Include the leachate collection system in the Operation and Maintenance Manual. The Operation and Maintenance program should also include extensive training of on-site workers.

7.2 The ground water resource information contained in prior Midway reports is inadequate and inaccurate. The determination that the "most severe impacts" caused by the Midway Landfill are related to gas migration (pages 1-10) is largely a result of the inadequacy of earlier surface and ground water programs and incorrect evaluation of the water quality and water resource data.

The attached Figure A compares the ground water flow direction described in the Final EIS and illustrated in Figure II-5 of the Draft EIS to a more reasonable representation prepared by our firm. As shown, careful interpretation of the same data used in Figure II-5 produces a radial flow pattern.

Water quality conclusions using analyses of water from wells located immediately north of the landfill are not valid. For example, the Final EIS (page II-8) suggests that background specific conductance is 245 umhos/cm, based on analysis of water from Monitoring Well 1 located "up gradient of the landfill." However, readings from other wells in the area indicate that background specific conductance probably does not exceed 150 umhos/cm. Our analysis (Figure A) shows MW-1 lying in the path of landfill leachate.

Recommendation: Ignore the findings of prior ground water work at Midway. Sample existing and new ground water monitoring wells on a quarterly basis for at least one year. Augment the State's MFS analytical requirements to reflect hazardous wastes and contaminants known to be present in Midway refuse and leachate. Establish realistic background water quality values. To evaluate the performance of the leachate management plan, use practical evaluation rather than proposed statistical methods which mask seasonal and other natural water quality variations.

7.3 Ground water pumping is presented as a possible future alternative in case leachate is entering the ground water at unacceptable levels. Any landfill generated contaminant which is present above the MCL outside the landfill boundary (zone of compliance) is a violation and unacceptable.

Recommendation: Install leachate extraction wells as part of the leachate control plan. Wells should be completed in or immediately below the refuse in the interior of the landfill site. Wells should be operated to extract concentrated leachate undiluted by local ground water. Extracted leachate should be pumped through tight pipelines to Kent-Highlands Landfill and the Renton Sewage Treatment Plant.

7.4 Investigation of bioreclamation is suggested as a possible alternative for leachate treatment. The diverse nature of the contaminants present and potential negative impacts of the system make this an unattractive alternative.

Recommendation: Forget bioreclamation of leachate at Midway!

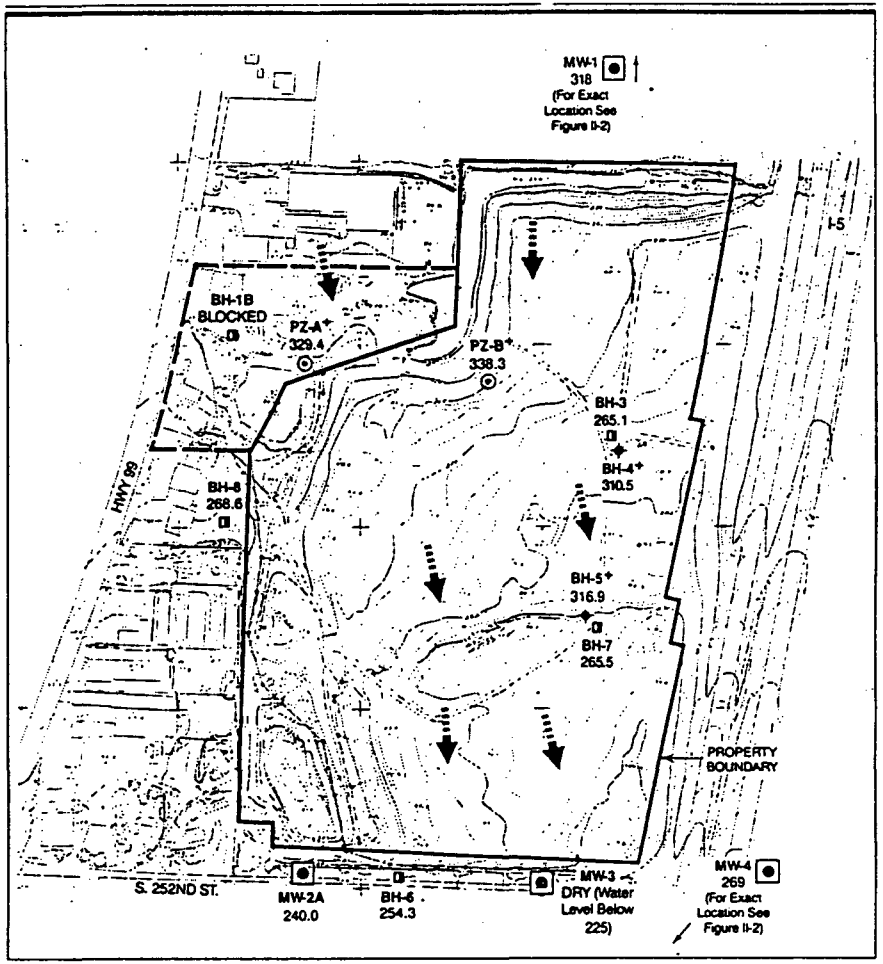
7.5 The land use discussion suggests that the listed activities might be initiated as soon as 2 to 4 years after closure. Since continual maintenance of surface grades is anticipated for 5 to 10 years following closure (page 2-1) no beneficial land use seems practical for at least 10 years.

Recommendation: No new land use activity should be initiated for at least 10 years or until the site is stable and all remedial activities are completed.

8.0 IMPLEMENTATION PLAN

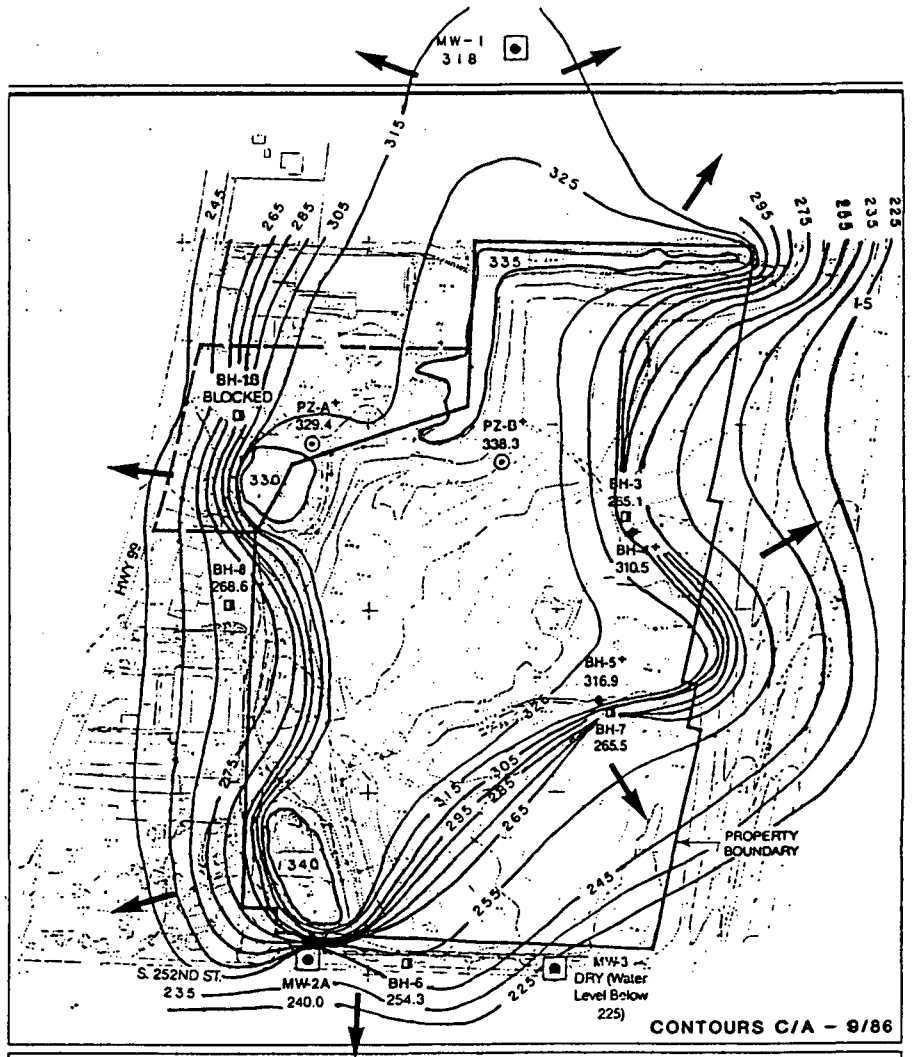
8.1 Design of the leachate management system apparently will be developed from results of the RI/FS. The schedule for the RI/FS probably cannot be met. Delay in implementing the leachate management system to mid-1988 or later is not a responsible alternative.

Recommendation: Install critical components of the leachate management and on-site drainage systems now (see Section 1.3 above).



ORIGINAL

Figure II-5.
Groundwater
elevations for wells
and piezometers at the
Midway Landfill.



MODIFIED

Figure II-5.
Groundwater
elevations for wells
and piezometers at the
Midway Landfill.

FIGURE 4-A

5.0 FINDINGS: HEALTH

5.1 ISSUES AND CONCERNS

Residents of the Midway Landfill have been concerned about possible health effects resulting from breathing air or drinking water contaminated by toxic substances generated by the landfill. Parents have also expressed concern about their children playing in ditches filled with runoff from the landfill.

Three general health effects might be expected from excessive exposure to the toxic substances associated with landfills:

* Subtle neurological symptoms such as headaches, dizziness and difficulty concentrating

* Symptoms caused by interaction of these substances with prescription drugs and other environmental pollutants such as automobile exhaust

* Symptoms caused by products of thermal degradation of these substances, such as when they are exposed to furnaces, heat ducts and other heat sources

* Slight increase in risk of cancer or mutations

This section responds to several questions posed by L.I.F.E. to the Technical Advisory Team:

* Is there enough data available to assess the potential hazard of landfill chemicals which have migrated off site? Have the detection limits of tests done so far been sensitive enough and have the tests looked for the right chemicals?

* Have past attempts to assess health hazards been honest and complete?

* What new data has become available since previous attempts to assess health hazards were done, and what is the significance of the new data?

5.2 EVALUATION OF DATA

5.2.1 Data Reviewed

The L.I.F.E team has reviewed three data sets:

* Landfill gas composition data measured on site in 1984 and 1985 by Laucks Laboratory and the University of Washington

* Landfill gas composition measured off site in 1986

* Ambient air grab samples measured in the gas seepage area east of I-5 and in a distant area which is also close to I-5 (1986)

The team also reviewed two health impact assessments, found in Appendix O of the Midway Closure Plan Final EIS (May 1986). These assessments were performed by Environmental and Occupational Health Associates/Dr. Ronald Fessenden (Ref. 5-1) and the University of Washington Ad Hoc Committee (Ref. 5-2).

It was not the purpose of this study to fully analyze the effects of each chemical present in the air of the neighborhood surrounding the Midway Landfill. Rather, this report reviews existing data and previous studies in the light of recent research findings. Problems and deficiencies are pointed out in order to provide guidelines for a more complete future analysis of health hazards to the neighborhood.

5.2.2 Adequacy of Data

In general, not enough data on toxic substances in the air or water is available to adequately assess potential health hazards. Tests have been performed for relatively few of the many toxic substances potentially present and have not considered the cumulative and synergistic effects of long-term exposure to low dosages of multiple toxic substances. In the absence of adequate data, previous studies have concluded that health effects are minimal.

All of the volatile organic compounds found in extraction well emissions at Midway would be classed as chemicals in commerce. The National Research Council's 1984 Study of Toxicity Testing (Ref. 5-3) concluded that "chemicals in commerce as enumerated in the inventory of the Toxic Substances Control Act have had least adequate testing. On no substance in the three production categories of chemicals in commerce examined by the committee, is information sufficient to submit a complete health hazard assessment. Partial assessments could be made for 10 - 37% of the substances. Complete health hazard assessments appear to require further testing of 82% of the drugs and excipients in drug formulations, 90% of the pesticides and inert ingredients of pesticide formulations, 95% of the food additives, 98% of the cosmetic ingredients and essentially all the substances in the three production categories of chemicals in commerce."

This means that current standards for exposure to solvents such as those found at Midway are based on inadequate and incomplete data. Many such standards will undoubtedly be set at lower levels of exposure in the future after appropriate testing has been done. This has already happened many times, such as after the recognition that Benzene is a carcingogen.

5.2.3 Toxic Chemicals Found at Midway

Volatile Organics

In 1986, 23 volatile organic compounds were found in off-site gas extraction wells, all of which are very rapidly absorbed in the lungs and distributed throughout the body. Fourteen volatile organics were detected in surface and ground water samples (see Table 4-4).

Table 3-2 lists 18 volatile organic compounds detected at some air sampling stations. Two compounds listed as not detected at these stations were detected at other sampling sites:

Chloroform
1,1,1-Trichloroethane

Three compounds not listed in Table 3-2 were also detected in other sampling sites:

1,1,2-Trichloroethane
2-Hexanone
Styrene

Of these 23 compounds, 20 are of sufficient concern to be on EPA's list of priority pollutants.

Neurotoxic Substances. All but one of the 23 volatile organic compounds found in detectable levels in off-site air vents are reported as having neurotoxic effects (Ref. 5-4). The exception, trans-1,2-Dichloroethene, probably has unreported neurotoxic effects.

Two other neurotoxic chemicals, detected on site, were not detected during the 1986 off-site sampling:

1,2-Dichloroethane (Ethylene dichloride)
1,2-Dichloropropane (Propylene dichloride)

Five neurotoxic chemicals, detected on site, were not included in the 1986 off-site sampling:

Hydrogen cyanide
Hydrogen sulfide
4-Methyl-2-pentanone (Methyl isobutyl Ketone, MIBK)
Nonane
Octane

All 14 volatile organics found in water samples (see Table 4-4) have neurotoxic effects.

Carcinogenic Substances. Chemicals found in air and/or water samples at Midway which are accepted as carcinogenic based on EPA's cancer risk assessment (Ref. 5-5) are:

Benzene
Chloroethene (Vinyl chloride)
Trichloroethene (TCE, Trichloroethylene)
1,2-Dichloroethane (Ethylene dichloride)
Chloroform
1,1-Dichloroethene
Dichloromethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
Tetrachloroethene

Other chemicals found in air and/or water samples whose test results suggest carcinogenicity (Ref. 5-5) are:

Chlorobenzene
Chloromethane (Methyl chloride)
1,1-Dichloroethane
1,2-Dichloropropane
bis(2-Ethylhexyl)Phthalate
1,1,1-Trichloroethane

Semi-Volatile Organics

Semi-volatile organic compounds detected in water at the Midway Landfill include Bis-2-ethylhexylphthalate, Naphthalene and 2-Methylnaphthalene (Table 4-4). Bis-2-ethylhexylpthalade is a plasticizer, sometimes called DEHP. It is a component of plastics discarded in household garbage which can be leached from the plastic. This compound is of concern because it is a suspect carcinogen. Naphthalene and 2-Methylnaphthalene are polycyclic aromatic hydrocarbons. Naphthalene and DEHP have shown neurotoxic effects.

Ambient Air Samples

The data from the grab sample of ambient air taken in the playground of the Baptist Church on the east side of the Midway Landfill and I-5 indicate that the particular solvents found in ambient air as a result of freeway emissions and other industrial emissions in the area are far greater than the amounts of those same solvents produced by the extraction wells. Therefore the contribution of the extraction wells to these particular solvents in the ambient air of the Linda Heights neighborhood is insignificant. However far more different solvents were found in the gases venting from the extraction wells, and this qualitative difference in composition is important in evaluating potential health effects from air pollutants.

5.2.4 Potential Health Effects

The 23 chemicals found in off-site extraction wells can be grouped by structure into four classes of related solvents: aromatic hydrocarbons, ketones, carbon disulfide and chlorinated hydrocarbons. This section reviews the possible effects of low dose chronic exposure to these solvents alone or in combination with each other.

Aromatic Hydrocarbons

Of the 23 compounds found in off-site wells, five are aromatic hydrocarbons: Benzene, Ethylbenzene, Toluene, Styrene and Xylene. The early effects of chronic exposure to these compounds include headache, fatigue, loss of appetite and weakness. More extreme symptoms may include confusion and poor coordination. These central nervous system effects should be considered to be at least additive. In other words, the effect will be in proportion to the total amount of exposure to the five solvents. These symptoms are not easy to detect or measure in test animals and therefore are often ignored in determining so-called safe levels of exposure. Sensitive neuropsychological tests are available to assess subtle neurological damage in humans, but without testing prior to exposure, individual differences make any but serious injury impossible to confirm.

In higher dosage, aromatic hydrocarbon solvents can cause damage to the liver and kidneys. This would not be relevant to the extremely low dosage resulting from landfill emissions except for the additive effect of multiple solvents and the demonstrated synergism of xylene liver toxicity by ingestion of alcohol. This combination has produced severe liver damage in dosages where exposure to either xylene or alcohol alone did not cause detectable liver damage (Ref. 5-6). This means that exposure to the aromatic hydrocarbon solvents increases the risk of liver damage in persons who drink alcoholic beverages.

Ketones

The second group of organic compounds found in extraction well emissions consists of three ketones: Acetone, 2-Butenone (Methyl ethyl ketone) and 2-Hexanone (Methyl n-butyl ketone). Acetone and Methyl ethyl ketone are thought to be relatively innocuous solvents in comparison to the others. However, 2-Hexanone is a neurotoxic compound capable of causing peripheral neuropathy in the same manner as does Hexane, a major component of gasoline (Ref. 5-7). It has been demonstrated numerous times that Methyl ethyl ketone, while causing no peripheral nerve damage itself, can greatly synergize the peripheral neurotoxicity of 2-Hexanone and Hexane (Ref. 5-8). (Hexane was not looked for in any of the landfill emission sampling; however, it is extremely likely that this widely-used compound is present.) The central nervous system is the principal target for the ketones. With sufficient exposure, they cause central nervous system depression, fatigue, loss of certain reflexes and changes

in vision.

Carbon Disulfide.

Carbon disulfide is the only compound in the third group. It is a very insidious, slowly crippling neurotoxic chemical. Chronic exposures to low levels of carbon disulfide cause mental fatigue, irritability, loss of appetite and behavioral changes. Many years of low level exposure or repeated episodes of higher level exposure over several years leads to polyneuritis, tremors, spasticity and jerking of the limbs, difficulty with balance, mental deterioration and eventually psychosis. These symptoms do not disappear but tend to increase after discontinued exposure to carbon disulfide (Ref. 5-9).

Chlorinated Hydrocarbons

The fourth group of volatile organic compounds found in extraction well emissions consist of 14 chlorinated hydrocarbons. Chlorobenzene is an aromatic compound while the other 13 are a combination of 1 or 2 carbon atoms with from 1 to 4 chlorine atoms attached. The common biological effect of these chlorinated hydrocarbons is anesthesia, which is a toxic effect on the central nervous system (Ref. 5-10). Milder central nervous system symptoms following exposure to these compounds include poor coordination, inebriation, impaired judgement, mental retardation, lethargy, stupor, dizziness, loss of appetite and tremor.

5.2.5 Effects of Toxic Interactions

Exposure to Multiple Toxic Substances

Simultaneous exposure to many toxic chemicals at levels where any one chemical alone would not produce detectable toxic effects may result in either subjectively or objectively measurable adverse effects. When many of those chemicals have similar effects on the same organ system, such as central nervous system, it must be expected that these effects would be at least additive. Other less obvious interactions can involve the processes of adsorption into the body, elimination from the body, biotransformation within the body, storage in the body and interaction with the target organ. Such toxicological interactions have been largely ignored and there is insufficient data available to do any reasonable quantitative risk assessment for the combination of chemicals found in landfill extraction well gases.

Scientific and medical journals contain many reports of human exposure to multiple solvents in which significant central nervous system toxicity is reported and recovery is prolonged and often incomplete even after cessation of exposure. Significant results from these studies include the fact that total exposure to less than the Threshold Limit Value (TLV), calculated by summing the fractions of TLV's of each component of exposure, may

result in significant neurotoxic effect. This demonstrates synergistic rather than simply additive effects on the central nervous system.

Followup after several years of people poisoned by solvents has shown improvement in subjective symptoms, but continuing increased disability related to objective clinical signs. In other words, after ending the exposure, the people felt better but they were not necessarily physically better (Refs. 5-11a-h). The slow and incomplete recovery from central nervous system toxicity is probably related to the fact that functional nervous system cells do not multiply in human brain postnatally by cell division and therefore surviving neurons and other cells in an injured brain may only modify their own function in an attempt to restore their former capacity (Ref. 5-12).

A very useful source of information on the potential for interaction between toxic chemicals is the 1980 report of the National Research Council's Committee on Maritime Hazardous Materials (Ref. 5-13).

Environmental Interactions

Interactions of chemical exposure with environmental factors also are known to occur and are also insufficiently studied at the present time. Such factors include: cold, heat, noise, vibration, pre-existing disease states and relative lack of oxygen, water or food.

5.2.6 Need for Behavioral Testing

Behavioral tests have been developed by neuropharmacologists and psychopharmacologists for studying psychotropic drugs. These same tests should be applied to the study of atmospheric pollutants which have been reported as producing behavioral changes in humans, presumably by virtue of their actions on the central nervous system (Ref. 5-14). These behavioral changes can be produced by short periods of exposure to high concentrations or long periods of exposure to low concentrations.

Behavioral testing of the effects of trichloroethylene have been carried out in test animals by Silverman (Ref. 5-14 and 5-15), and behavioral changes can be demonstrated relatively easily. Observed aspects of the behavior of rats exposed to trichloroethylene all were reduced with respect to unexposed controls. This is in agreement with symptoms of mental confusion and fatigue reported by exposed humans. Silverman wrote: "I was surprised to find just what the layman would expect of small doses of an anesthetic." He added that "humans are assumed to be more, not less sensitive to drugs than rats are. So if rats show an effect of trichloroethylene at 100 parts per million, we must expect something in man. We can only speculate about what kind of effect, but a decline in the maximum rate of activity in rats is what you would expect if they were suffering from drowziness, fatigue or headaches complained of by people."

Behavioral testing can detect central nervous system toxicity at exposures lower than those which produce any physical effect. Brimblecombe (Ref. 5-14) has emphasized that it is essential to ensure that tests designed to detect possible effects of a chemical substance on behavior are carried out using doses of the substance which do not cause physical effect, otherwise these physical effects may be misinterpreted in behavioral tests as being effects on behavior.

5.2.7 Previous Health Impact Assessments

Review of Public Health Issues

Dr. Fessenden's analysis (Ref. 5-1) considers only those chemicals in landfill gas which cause obnoxious odors. It totally ignores the far less odorous highly toxic chemicals which are also found in landfill gas. All the physical effects reported by neighbors of the landfill are attributed to the psychological effect of the odor problem. This is equivalent to saying that a person whose spouse chain-smokes has a chronic cough and difficulty breathing because she dislikes the odor of the cigarettes.

Particularly inappropriate is the statement on the last page of Dr. Fessenden's report in which he claims that persons such as elderly people and pregnant women are at higher risk of suffering from stress-related symptoms. He states that these symptoms would not necessarily be due to emissions from the landfill but rather from stress-related symptoms caused from living near it.

Pregnant women and elderly people who are on medication for various chronic health problems are certainly not any more prone to psychological stress than anyone else, but they are at higher risk of suffering physiological stress from landfill emissions. Pregnant women normally have a somewhat elevated level of methemoglobin in their blood. This would increase their susceptibility to respiratory distress from certain chemical exposures. Many elderly people take prescription drugs which are either activated or inactivated by enzyme systems which are affected by certain landfill gases. This can alter the effectiveness of the prescription drug by creating either an overdose or underdose.

The tendency of many physicians to blame subjective physical discomfort on psychological factors reflects their lack of knowledge of the toxicology of suspect chemicals and their unwillingness to put forth the effort to find out what the expected effects of such exposure should be.

The symptoms reported by participants in the Health Department's 1983 survey (Ref. 5-16) are precisely those symptoms which can be expected to result from living in an area of significant air pollution.

Potential Health Effects

The study by the University of Washington Ad Hoc Committee (Ref. 5-2) does not consider the many chemicals which have been identified in the off-site extraction wells in 1986. Also this more recent testing gave higher levels of some of the chemicals which the study does discuss. Therefore, the Ad Hoc Committee underestimates risks both quantitatively and qualitatively.

Neighbors of the Midway Landfill are experiencing a very low level chronic exposure to multiple toxic chemicals. Yet this study places great emphasis on acute lethal doses, implying that exposures of the people concerned are infinitesimal and therefore insignificant. The lethal dose of a chemical cannot be extrapolated to a safe level for chronic exposure as there is no numerical relationship between these two numbers other than the fact that the lethal dose is higher. The ratio of lethal dose to the highest dose producing no adverse effect in a test animal can vary anywhere from approximately 10:1 to at least 200,000:1.

The Ad Hoc report admits on page 3 that occupational air standards or a modification of these standards are not intended to be used in evaluating community air pollution problems. Nevertheless, the report proceeds to use these standards for just such a purpose. The report cites an organization of engineers (ASHRAE) for the recommendation that the concentration of a given contaminant should not exceed 10% of the occupational standard. This is not in agreement with the guideline values circulated by the EPA's Toxics Clearinghouse to assess ambient impacts on the general population. These guideline values are typically 1/300th of the occupational standard or less (Ref. 5-17). Experimental data has indicated that ambient air standards should be set far lower than this (Ref. 5-18).

In the University of Washington report, discussion of increased cancer risk due to landfill emissions is numerically correct but quite misleading in its attempt to play down the significance of the carcinogenicity of landfill gases. The report fails to note that an increased risk of 567 cancer cases per million people is considered totally unacceptable for unwilling or unknowing exposure (persons who have not chosen to take this risk). A risk of 1 in a million due to a particular exposure situation is generally considered to be acceptable if the exposure cannot be entirely eliminated. Comparison of such an exposure risk to the risk of cancer from all causes is irresponsible and belittles the significance of the risk from exposure to carcinogenic landfill gases. The comparison of risks from environmental exposure to risks from certain specific lifestyle choices is also inappropriate. Many people deliberately choose not to indulge in carcinogenic lifestyles and do not wish to deliberately increase their risk of cancer by any other means including environmental exposure to carcinogenic chemicals.

5.3 ADEQUACY OF PLANNED ACTIONS

5.3.1 Closure Plan

The draft Closure Plan issued in September 1986 does not address toxicological effects of the landfill except for the single exaggerated and unreferenced statement on page 6-5 to the effect that the analysis of the discharge from the off-site gas extraction wells has shown that no health hazards will be created by venting them to the atmosphere.

5.3.2 Remedial Investigation Plan

Appendix A of the final project work plan for the RI, July 1986, outlines the endangerment assessment to be conducted on the potential health impacts of hazardous substances from the landfill. The plan is quite good and includes relevant health effects such as neurotoxicity and immunodepression which were not considered in earlier reports. However, the endangerment assessment also should consider additive and synergistic effects of the mixture of chemicals to which people are exposed, and toxicological interactions of these chemicals with other environmental conditions.

5.4 CONCLUSIONS

With the limited data available, no definitive conclusions can be drawn about the health effects of toxic substances generated by the landfill. However, the following general statements can be made:

1. Concentrations of landfill gas which were seeping into basements prior to installation of extraction wells were probably sufficient to have caused or exacerbated some of the residents' symptoms of ill health.

2. Extraction wells and perimeter migration control systems installed in late 1985 apparently have greatly reduced residents' exposure to toxic gases. Concentrations of gases vented from these sources which reach the breathing zone of residents are probably not any hazard to the health of the local population.

3. Air dispersion modeling indicates that the concentration of any one pollutant in the breathing zone of a resident near the extraction wells would be too low to cause symptoms. However, the additive or synergistic interactions between these chemicals could have caused symptoms before the installation of extraction wells.

5.5 RECOMMENDATIONS

The endangerment assessment conducted as part of the Remedial Investigation Plan should consider:

1. Additive and synergistic effects of the mixture of chemicals to which people are exposed.

2. Toxicological interactions of these chemicals with other environmental conditions.

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